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ELECTRIC LIGHTING PROSPECTS.

As a general principle we are not altogether in favour of the practice occasionally resorted to by joint stock companies of issuing fresh capital; but there are circumstances the occurrence of which may sometimes render it a politic course to adopt. Such circumstances would seem to have arisen in the case of the Maxim-Weston Electric Company, whose recent meeting we report in another part of the present issue. This company has, like most electrical companies, had a somewhat chequered career. First there was a time of immense promise and feverish excitement; but electric lighting fell into sudden and not altogether unaccountable disrepute, total collapse seemed imminent, and those who held shares would gladly have rid themselves of them at almost any sacrifice. To crown all, the system of management in many instances was of the loosest kind, and matters became involved in an almost hopeless muddle. Of course some companies suffered more than others during this panic time, but not one totally escaped; indeed, the wonder is, seeing the huge blunders which were made, that a single survivor remains to remind us of what is now fast becoming ancient history. But a few of these undertakings contained elements which ensured their continuance, and amongst these the Maxim-Weston Company was by no means the least important. It was for this company a great piece of good fortune that it was able to secure the services of Mr. Hugh Watt, who, to say the least, has been energetic and untiring in its behalf. Under his superintendence reorganisation has taken place, numerous economies have been effected, a thorough system of supervision has been initiated, and the company has been enabled to regain its feet. From time to time lately we have heard of the increase of electrical business in various parts of the country, and evidently this particular company has not been behindhand in securing its share of what was to be had. Mr. Watt on Monday informed his hearers that the business has just doubled in volume during the past twelve months, and whilst this has not produced a corresponding doubling of the company's income, there has yet been a valuable increase in the receipts of the year. This is all very satisfactory, and points to a still more rosy state of things in the future. The Government is largely extending its support to the electric system of illumination, and it is to take advantage of this fact, Mr. Watt explained, that the Maxim-Weston Company has found it necessary to make a fresh issue of 100,000 shares. We wish this and other electrical companies all success. Our columns week by week testify to the general extension of electric lighting, and there seems every promise that such of the companies as remain in the field and are not so encumbered as to involve themselves more deeply the more business they undertake, will find plenty of work to occupy their attention. A financial contemporary asks, "What would the public say to a fine, healthy revival of electric lighting?" and half prophesies another "boom." Whilst we are not quite so sanguine as some people were four years ago, and whilst we are not particularly desirous that the particular kind of boom shall come which, we fear, our financial contemporary is best able to appreciate, we yet have every confidence that the healthy revival of electric lighting as a genuine industry will not be long delayed; in fact, it is our belief that it is now in progress.

THE INVERSE ELECTROMOTIVE FORCE OF THE VOLTAIC ARC.

By CHAS. R. CROSS AND WM. E. SHEPARD.*

(*Concluded from page* 300.)

It is interesting to examine Edlund's early values for the inverse electromotive force in the light of the preceding results. His first values are expressed in units which are purely arbitrary. They show, however, approximately the same figure for *a*, C, through a considerable range of variation in the strength of the current. His later results give 9·7 as the value of the inverse electromotive force with a current of 30 Bunsen elements, the electromotive force of a Bunsen cell being taken as a unit. With 50 elements its value rose to 15. It seems probable that the former result was reached with a whistling arc, and the latter with a silent one. It is difficult to explain the existence of certain intermediate values, but the method by which they were obtained is liable to great errors.

If we consider Peukert's paper we find that the results from which he derives his value of 35 do not include any with a less current than 10 ampères, and but one in which the length of the arc is less than 2 mm., so that the arcs were probably all silent. The observations from which Fröhlich constructs the curve giving the value of 39 are too irregular to show any difference that might exist between the values of the constant for the silent and for the whistling arcs. Von Lang states that the arcs measured by him were carefully kept from hissing by manual adjustment.

A large number of measurements were made with an inverted arc, in which the positive carbon was below and the negative one above.

Currents of approximately 5, 7, and 10 ampères were used, with lengths of arc up to $\frac{7}{32}$ inch. There was much unsteadiness in the voltmeter for arcs more than $\frac{3}{32}$ inch long, there being a slow and irregular fluctuation of the needle between definite limits. Very probably this was due to irregularities in the air currents rising from the lower and hotter positive carbon. In some sets of the measurements (series II. of tables) the extreme readings were taken and separate curves drawn for each. The following tables (XI. to XVII.) give the results of the measurements:—

INVERTED ARC.—SERIES I.

TABLE XI.
Current = 5·1 ampères.

Length.	Resistance.
·50	3·88
1	4·91
2	7·50
3	9·00
4	9·50
5	9·90
6	10·60

TABLE XII.
Current = 7·3 ampères.

Length.	Resistance.
1	3·22
2	4·64
3	5·85
4	6·49
5	6·76
6	6·91
7	7·14
8	7·38

* Read at a meeting of the American Academy of Arts and Sciences, June 16th, 1886.

INVERTED ARC.—SERIES II.

TABLE XIII.

Current = 5·1 ampères.

Separation.	Resistance.	
	Minimum.	Maximum.
·50	3·86	...
1	5·05	5·48
2	6·98	8·23
3	8·81	9·52
4	9·33	10·38
4	9·14	9·97
5	9·52	10 60
6	9·81	11·01
7	10·40	11·43
8	10·40	12·00
9	10·80	12·50

TABLE XIV.

Current = 10·2 ampères.

Separation.	Resistance.	
	Minimum.	Maximum.
3	3·06	3·83
4	3·60	4·70

TABLE XV.

Current = 9·6 ampères.

5	4·10	5·17
6	4·18	5·27
7	4·18	5·60

The curves for the inverted arc were constructed, as already explained, for the upright arc. These were found, as with the latter, to consist of two distinct straight lines, corresponding to the silent and the whistling arcs respectively. The following equations (tables XV., XVI.) represent the results obtained. Equations 10 and 12 were found by taking the extreme readings as described, the current being steady at 5·1 ampères. Equation 11 was obtained from another series of experiments, using the same strength of current, but taking the mean reading of the voltmeter at each observation. Equations 14 and 15 were constructed from the extreme readings. The current varied slightly with these last, the average value being 9·6 ampères for the silent arc and 10·2 ampères for the whistling arc. The inverse electromotive force is given in the last column of the table.

TABLE XV.—SILENT ARC.

Current.	No.	Equation.	E.M.F. = $a \times c$.
5·1 (*max.*)	10	$r = 7{\cdot}70 + {\cdot}540\,l$	39·27
5·1	11	$r = 7{\cdot}70 + {\cdot}450\,l$	39·27 } 39·27
5·1 (*min.*)	12	$r = 7{\cdot}70 + {\cdot}367\,l$	39·27
7·3	13	$r = 5{\cdot}60 + {\cdot}214\,l$	40·88 – 40·88
9·6 (*max.*)	14	$r = 4{\cdot}01 + {\cdot}230\,l$	38·50 } 38·07
9·6 (*min.*)	15	$r = 3{\cdot}92 + {\cdot}052\,l$	37·63
			Mean ... 39·41

TABLE XVI.—WHISTLING ARC.

Current.	No.	Equation.	E.M.F. = $a \times c$.
5·1 (*max.*)	16	$r = 2{\cdot}95 + 2{\cdot}67\,l$	15·04
5·1	17	$r = 2{\cdot}85 + 2{\cdot}07\,l$	14·54 } 14·71
5·1 (*min.*)	18	$r = 2{\cdot}85 + 2{\cdot}03\,l$	14·54
7·3	19	$r = 1{\cdot}95 + 1{\cdot}32\,l$	14·23 – 14·23
10·2 (*max.*)	20	$r = 1{\cdot}30 + {\cdot}846\,l$	13·26 } 13·26
10·2 (*min.*)	21	$r = 1{\cdot}30 + {\cdot}583\,l$	13·26
			Mean ... 14·07

It will be seen from the figures in the last column that the fluctuations of the voltmeter to which we have referred were, for the most part, due to variations in the conductive resistance of the arc, the inverse electromotive force being almost constant for the same current, notwithstanding the variations occurring in the total resistance. With the whistling arc the inverse electromotive force is decidedly less for the same current in the inverted than in the upright arc, and the same is probably true to a less degree with the silent arc, though this is not so clearly shown in our observations, partly on account of an exceptionally high value for the inverse electromotive force with the current of 7·3 ampères and inverted arc.

It will also be observed that the corresponding values of the conductive resistance (bl) and the total equivalent resistance are both somewhat less for the inverted arc. This differs from a result somewhat doubtfully recorded by Niaudet (*Machines electriques a courants continus*; p. 133).

The points of intersection of the lines corresponding to the two varieties of the inverted arc are given in the following table, as read from the curves. They may also, of course, be obtained by solution of the equations.

TABLE XVII.

Current.	Equivalent resistance	Distance between carbons.
5·1 (*max.*)	8·92	$\frac{2{\cdot}2}{32}$ = ·069 in.
5·1	9·05	$\frac{3{\cdot}0}{32}$ = ·094 in.
5·1 (*min.*)	8·74	$\frac{2{\cdot}9}{32}$ = ·091 in.
7·3	6·32	$\frac{3{\cdot}3}{32}$ = ·103 in.
9·6-10·2 (*max.*)	5·02	$\frac{4{\cdot}4}{32}$ = ·137 in.
9·6-10·2 (*min.*)	4·16	$\frac{4{\cdot}9}{32}$ = ·153 in.

Comparing this with the table already given for the upright arc, it appears that with the inverted arc the length at which the higher inverse electromotive force sets in is somewhat greater. The corresponding equivalent resistance is not greatly different in the two cases.

Measurements were also made of the resistance of arcs into which certain metallic salts had been introduced. The salt, in powder, was placed on the lower (negative) carbon while this was quite hot, care being taken to entirely cover the carbon point, and to keep the powder from being jarred off on forming the arc. The reading of the voltmeter for a given length of arc remained quite constant for a short time after the arc was established, so that readings could readily be obtained.

Observations were made with arcs containing biborate of soda, sulphate of soda, and sulphate of potash. The arcs employed were from $\frac{1}{32}$ to $\frac{4}{32}$ in. in length with the biborate of soda, from $\frac{3}{32}$ to $\frac{5}{32}$ with the sulphate of soda, and from $\frac{1}{32}$ to $\frac{16}{32}$ with the sulphate of potash. The current was approximately 5 ampères. The equation $r = a + b\,l$ still expressed the results as follows :—

TABLE XVIII.

Current.	Salt.	No.	Equation.
5·10	Biborate of Soda	22	$r = 1{\cdot}25 + {\cdot}290\,l$
4·94	Sulphate of Soda	23	$r = 2{\cdot}20 + {\cdot}418\,l$
5·10	Sulphate of Potash	24	$r = 1{\cdot}77 + {\cdot}223\,l$

The values of the inverse electromotive force were for biborate of soda 6·38 volts, for sulphate of soda 10·86 volts, and for sulphate of potash 9·03 volts. The conductive resistance, as well as the inverse electromotive force, is diminished by the presence of the salts in the arc.

The data from which the curves giving the preceding equations were constructed, are given in the following tables.

Whatever may prove to be the real cause of the inverse electromotive force of the arc, it is clear that it is intimately connected with variations in the temperature of the carbons. Thus both the actual temperature and the difference of temperature between the carbons is greater with the silent than with the whistling arc, and at the same time the inverse electromotive force of the former is the higher. Again, the temperature of the carbons is apparently lowered when metallic salts are introduced into the arc, and the inverse electromotive force falls at the same time. Edlund (*Pogg. Ann.*, vol. cxxxiv., p. 250) found that

by heating the negative carbon by a blast-lamp, the inverse electromotive force was raised; but this was not the case when the flame of the lamp was directed against the positive carbon, and in fact there then seemed to be a fall. It seems very probable that this last result came from the fact that the positive carbon was so much hotter than the flame that the effect of the latter was on the whole to cool the arc. We endeavoured to increase the temperature of the positive carbon in a different manner, by surrounding it with a deep cup-shaped shield of fire-clay, which projected over the end of the carbon so as to envelop the arc, thus preventing radiation. At the same time a broad, flat, horizontal plate of brass was attached to the lower and negative carbon. This obstructed the access of air to the arc, and thus tended to keep up its temperature.

TABLE XIX.
Biborate of Soda.
Current = 5·10 Ampères.

Length.	Resistance.
1	1·53
2	1·82
3	2·12
4	2·41

TABLE XX.
Sulphate of Soda.
Current = 4·94 ampères.

1	2·64
2	2·98
3	3·43
4	3·85
5	4·00

TABLE XXI.
Sulphate of Potash.
Current = 5·10 Ampères.

Length.	Resistance.
1	2·00
2	2·21
3	2·49
4	2·71
5	2·96
6	3·08
7	3·29
9	3·82
11	4·21
13	4·58
15	4·91

A current of 7 ampères was employed, with arcs varying from $\frac{1}{32}$ to $\frac{12}{32}$ inch in length. As the carbons could not be filed in these experiments, the length of the arc was obtained by screwing the points into contact while the current was passing and then separating them to the required distance. A moderately high wire resistance was placed in the circuit with the arc, so that there was no material change in the strength of the current and condition of the dynamo machine caused by this adjustment of the carbons, and the needed measurements could be made rapidly. There was considerable periodic fluctuation of the reading of the voltmeter, as had been noticed previously with the inverted arc, and two curves were drawn corresponding to the extreme readings. The current was sensibly constant. The highest set of values for the equivalent resistances corresponding to different lengths of arc are satisfied for the silent arc by the equation (25) $r = 6{\cdot}70 + {\cdot}16\ l$, and for the whistling arc by the equation (26) $r = 3{\cdot}02 + 1{\cdot}10\ l$. The corresponding values of the inverse electromotive force are 46·9 volts, and 21·1 volts. The lowest set of values are satisfied by the equations (27) $r = 6{\cdot}70 + {\cdot}09\ l$ for the silent arc, and (28) $r = 3{\cdot}02 + {\cdot}97\ l$ for the whistling arc. The corresponding values of the inverse electromotive force are the same as before, viz.: 46·9 and 21·1, respectively, showing that the changes observed in the difference of potential between the carbons were due to variations in the conductive resistance, and not to variations in the inverse electromotive force of the arc. These resistance variations, while amply large to affect the readings of the voltmeter, were too small to produce any sensible change in the strength of the main current. It also appears by a comparison of the equations just given for the shielded arc with equations (2) and (7) that the coefficient of l is decidedly less with the shielded arc, showing that the conductive resistance of the arc is diminished by the increased temperature, as would be anticipated. The increased inverse electromotive force is much greater than we had expected to find it, and at first might lead one to surmise why, with the ordinary arc, the inverse electromotive force does not rise with increased strength of current. This is probably to be explained by the fact that the chief effect of an increase in current is to heat a larger area of the carbons to the same temperature, rather than to raise them to a considerably higher temperature.

Observing the position of the point of intersection of the lines representing the silent and whistling arcs, we find that the passage from low to high inverse electromotive force occurs with a length of arc of $\frac{3{\cdot}92}{32} = {\cdot}123$ inches for the line represented by equation (26) and of $\frac{4{\cdot}20}{32} = {\cdot}131$ inches for that of equation (28) which values are greater than those occurring with the normal arc and the same strength of current. The corresponding equivalent resistances are 7·34 ohms and 7·07 ohms.

We next tried the reverse experiment of cooling the upper positive carbon. This was done by surrounding the lower end of the carbon with a brass tube through which a current of cold water flowed. The negative electrode was left in its usual condition. The arc under these conditions was extremely unstable, the slightest breath would extinguish it, and even with a current of 10 ampères it could not be elongated to a greater length than $\frac{3}{32}$ of an inch. It was quite blue, whistled, and gave but very little light. The extreme length of arc used was $\frac{3}{32}$ inch with the weaker, and $\frac{2}{32}$ inch with the stronger current. Plotted curves gave the following equations, satisfying the observations with tolerable exactness:

Current.	No.	Equation.
7	29,	$r = 1{\cdot}67 + 1{\cdot}11\ l.$
8	30,	$r = {\cdot}70 + 1{\cdot}82\ l.$

The corresponding inverse electromotive forces are 11·7 volts and 5·6 volts respectively. Both of these are much below the value already found for the whistling arc under normal conditions. But we also find here, for the first time, a great difference between the inverse electromotive force with different currents. As with the normal arc, the higher value occurs with the lesser current. With the current of 7 ampères the conductive resistance is lower than with the normal arc, but with 8 ampères it is higher. Owing to the low inverse electromotive force, the total resistance is considerably less with both strengths of current.

It was our intention to observe also the effect of cooling the negative carbon, but this was prevented by an accident to the apparatus. There is no reason to suppose, in the light of Edlund's experiments already cited, that this would have made any change in the results.

This fall of inverse electromotive force with lowered temperature of the arc may be the explanation of the fall which occurs with the inverted arc, as the increased convection when the hot positive crater is turned upward may be sufficient to lower the temperature by a slight amount.

The following tables give the data from which our equations were determined:

TABLE XXII.
Positive Carbon Heated.
Current = 7 Ampères.

Length.	Resistance.	
	Minimum.	Maximum.
1	3·86	4·24
2	4·91	5·15
3	5·90	6·36
4	6·97	7·42
5	7·42	7·42
6	7·27	7·66
7	7·31	7·88
8	7·21	7·97
9	7·57	8·10
10	...	8·48
11	...	8·64
12	...	9·10

TABLE XXIII.
Positive Carbon Cooled.
Current = 7 Ampères.

Length.	Resistance.
1	2·72
2	3·96
3	4·99

Current = 8 ampères.

1	2·52
2	4·35

For observations on the arc formed under diminished pressure and in different gases, a metallic receiver was constructed in which the rod carrying the upper carbon passed through the closed top of the receiver, and was movable by means of a micrometer screw. A window set in the side of the receiver, allowed observation of the arc. The exhaustion could be read by an attached gauge. The rubber screw plug, through which the rod passed, was covered with oil or glycerine to dimish the leakage. The construction of the apparatus was greatly delayed by unforeseen circumstances, so that up to the present date we have been able to make only a very few experiments. Some difficulty has also been met with from the heating and vaporisation of portions of liquid which have leaked into the receiver. This was partially avoided by immersing the receiver in water. In the experiment thus far made with this apparatus, the pressure was 4 inches of mercury. Currents were employed of 5, 7·95 and 9·86 ampères respectively, with lengths of arc from $\frac{1}{64}$ to $\frac{6}{32}$ inches. In all the experiments the positive carbon was uppermost. The arc was found to be a whistling one up to the extreme limits obtained. The results of the experiments are given in table XXIV.

TABLE XXIV.

Current = 5·00 Ampères.		Current = 7·95 Ampères.		Current = 9·86 Ampères.	
Length.	Resistance.	Length.	Resistance.	Length.	Resistance.
·50	3·70	·50	1·69*	·50	1·75
1	4·42	1	2·45	1	1·97
1	4·33	1	2·57	1	2·09
2	5·38	2	3·06	2	2·42
2	5·38	2	3·21	2	2·42
3	7·12*	3	3·70	3	2·74
3	7·12*	3	3·66	3	2·92
4	7·68	4	4·28	4	3·32
		4	4·17	4	3·14
		5	4·93	5	3·86
		5	4·80		
		6	5·51		
		6	5·37		

* These values deviate greatly from the curves.

These results, when plotted as before, give straight lines, represented by the following equations :

TABLE XXV.

Current.	No.	Equation.	E.M F. = $a \times C$.
5·00	31	$r = 3·30 + 1·09\,l$	16·50
7·95	32	$r = 2·00 + ·57\,l$	15·90
9·86	33	$r = 1·70 + ·38\,l$	16·76
			Mean ... 16·39

These lines are all less inclined than those for the same current with whistling arc under normal pressure ; showing that as the arc is lengthened the resistance proper increases less rapidly when the pressure is reduced. The total equivalent resistance is, of course, greatly diminished by reduction of pressure, but this reduction seems to be wholly due to diminished conductive resistance, the inverse electromotive force for the arcs used, all of which were whistling ones, being even slightly greater than at normal pressure, so far as can be judged from the data at present obtained.

The scanty data at hand would not justify us, however, in concluding this apparent increase to be real. If such proves to be the case, the action is probably of the same nature as that supposed by Edlund to exist in the discharge of electricity in ordinary vacuum tubes ; that is, an increase in the opposition offered to the passage of electricity from the solid electrodes, as the pressure of the intervening gaseous medium is diminished. Further experiment, extending to higher vacua, and also with increased density is necessary, before any definite conclusions can be drawn as to this point.

In addition to those facts which are commonly recognised, the following conclusions seem to be justified by our experiments :

1. There is a definite inverse electromotive force for the whistling arc, whose value is approximately 15 volts.

2. The inverse electromotive force for both the silent and whistling arcs diminishes slowly as the current increases.

3. The inverse electromotive force, at least for the whistling arc, is less for the inverted than for the upright arc.

4. The great change in equivalent resistance which occurs when volatile salts are introduced into the arc, is chiefly due to a large fall in the inverse electromotive force, although there is at the same time a marked diminution in the conductive resistance.

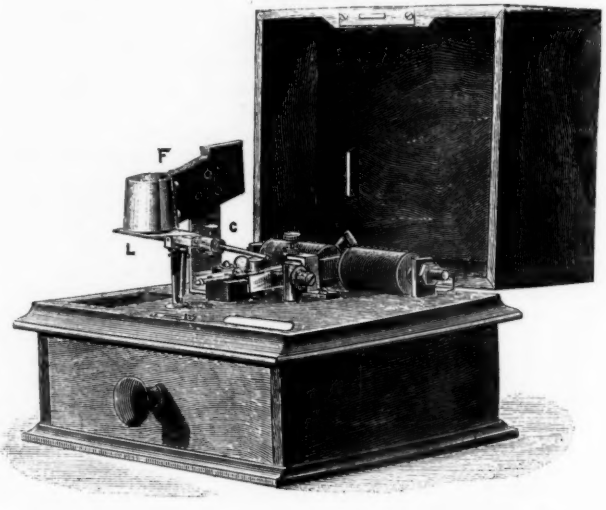
5. The diminished total resistance of the arc in rarefied air, is due solely to a diminution in the conductive resistance.

6. There is some evidence to show that with considerable reduction of pressure, there is a slight increase in the inverse electromotive force.

Rogers Laboratory of Physics,
June, 1886.

AUTOMATIC CALL BOXES FOR TELEPHONY.

THE Government having granted the telephone companies the privilege of opening public call stations where any person could by the payment of a specified amount obtain telephonic communication, many of these call offices being in out-of-the-way places where the calls may be comparatively few, it is out of the question to expect an attendant to be on duty to receive payment and open up communication with the exchange, and therefore apparatus has had to be devised to receive the subscriber's money and take the part of the attendant by opening up the line to the exchange.



The instrument illustrated in the fig. shows the "Crossley, Harrison and Emmott" call box which has been arranged to meet all the ordinary requirements of a call office, and which appears to be coming into very general use, which is but natural seeing that the apparatus is of such a simple nature.

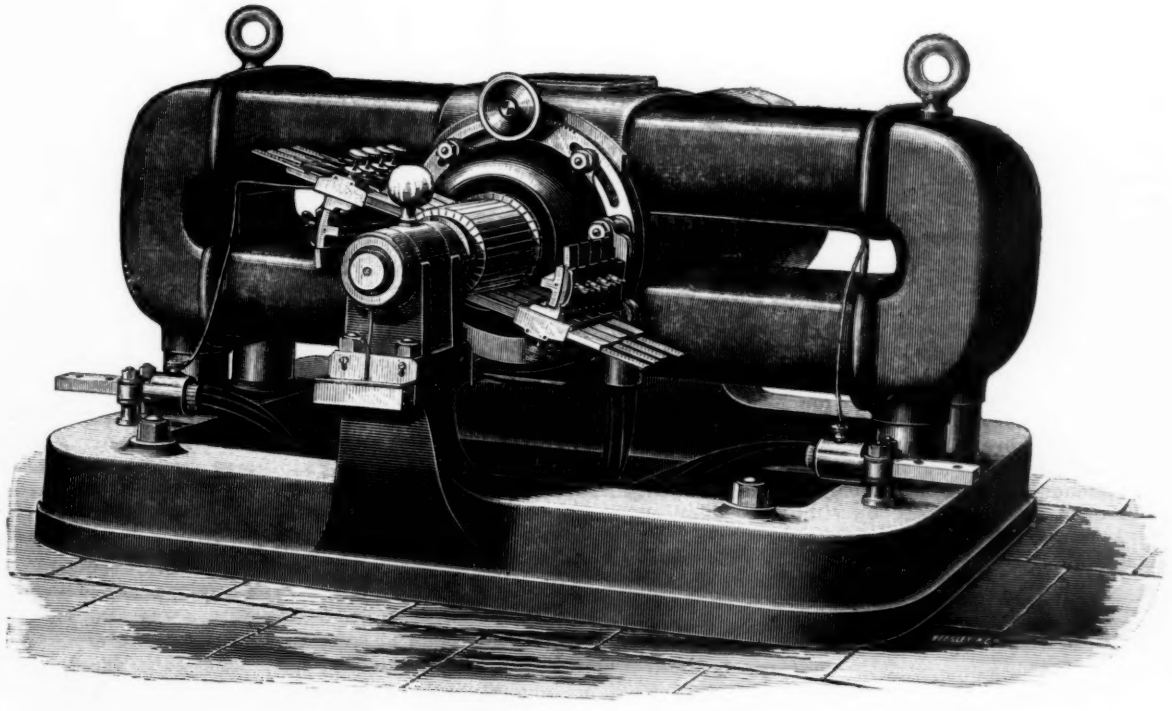
A suitable slit in the lid of the box communicates with the lever, L, by means of the funnel, F, and the money or voucher having been placed in this slit, rolls down to the table which is balanced by the counterpoise, C, and when the proper amount has been depo-

sited it is thrown into the drawer seen below by the overbalancing of the lever. This movement of the lever opens out the circuit to line by means of two contacts, and the subscriber can then obtain the attention of the exchange and communicate until the operator at the end of the specified time sends a current which throws the tongue of the relay back to its old position. This cuts off communication until a further consideration has been deposited in the box.

The relay is wound with a few layers of No. 20 B.W.G. wire, and the needle being heavy and sluggish in its action, does not respond to the rapidly-alternating currents from a magneto-generator of the type now so widely used with telephones, but immediately a current is sent from a battery the relay works, and thus closes or opens the line as required.

Other modifications of the foregoing form of call box have been invented, but we understand that they are of later date than the "Crossley, Harrison and Emmott," which appears to be the first patent for apparatus of this nature.

If desired, a simple train of clockwork can be started by the movement of the relay tongue, to cut off the communication at the end of a specified time, but it has in most cases been found advisable to leave the cutting off entirely with the exchange, with a view to cheapening and simplifying the apparatus at the call station.



THE BINGLEY HALL EXHIBITION, BIRMINGHAM.

THE exhibit of Chamberlain and Hookham, Limited, of West Bromwich, at this exhibition consists principally of the latest type of dynamo manufactured by the company. Its general construction will be understood from the accompanying engraving of a 30 unit machine. The heavy yokes and pole pieces are of cast iron, the magnetic circuit is well isolated from the frame, giving as a result perfect symmetry of field. The armature is of the drum type, with slots and projections similar to those of the Pacinotti ring. The low armature resistance is probably unexampled, being less than 3 per cent. in a 10 unit and less than 2 per cent. in a 30 unit machine. This is obtained in virtue of an arrangement which forms a claim in one of the company's early patents. The slots and ribs of the armature are so proportioned that the sum of the sectional areas of the ribs at any time opposite the pole pieces is equal to the magnetic section of the armature, so that but for the small clearance necessary between the ribs of the armature and the pole pieces the magnetic circuit is complete through iron. The result is exceptional intensity of field.

The brushes are of a new type. They seem to solve the problem of adjustment by end pressure, which has long been a desideratum. They are almost automatic in their action, only requiring the readjustment of a spring to compensate for wear. A brush of this kind has been on one of the company's plating machines in daily use for six months without being touched. Each machine has two or more brushes side by side, and each brush is capable of independent movement both in the direction of its length and also round the axis of the commutator.

The bearings of these machines are exceptionally long, and the steel spindles very strong and heavy, and in all mechanical respects these machines challenge comparison with any yet produced.

The 10 inches by 13 inches 25 unit nominal is the largest machine on view. It is shunt wound. The resistance of the armature is ·003 ohm hot, of the magnets 8 ohms. The speed is 960 revolutions per minute, and the E.M.F. 57 volts. The total energy converted into useful current is 26,635 watts; 610 watts are absorbed in the armature coils, thus giving a loss of 2·28 per cent. in the armature, 1·4 per cent in the magnets, and an electrical efficiency of 96·3 per cent. This particular dynamo is one of a set made for use in copper refining, and is designed to run 156 hours per week. For ordinary electric lighting its speed would be 1,000 revolutions per minute, and it would then develop 30 units with a still higher efficiency. A 7¼ inch by 9 inch 9 unit nominal dynamo is shown running as a motor by current from the Gülcher Company's dynamos which are lighting the Hall. This machine is identical with the one the company has just used in the installation at the Birmingham Art Gallery. By means of a band it drives a 25-light machine of an older pattern, which lights the lamps in the company's stand, thus affording a simple but in-

teresting example of double translation of energy. The machine has an armature resistance of 0·01 ohm hot, and at 1,250 revolutions per minute gives an E.M.F. of 57 volts at terminals, and has an electrical efficiency of 94·5 per cent.

The objects of next importance on the company's stand are its patent interchangeable wall couplings and lamp holders, which are extremely simple, and make at the same time a thoroughly good electrical and mechanical connection.

A patent automatic switch for use in charging storage batteries and heavy current switches of novel design are also shown.

The general impression produced by a careful examination of the company's apparatus is that the causes of failure which have done electric lighting so much harm in the past have been kept steadily in view and effectually avoided.

ELECTRIC THERMOMETRY.

PROF. T. C. MENDENHALL read a paper upon this subject at the recent meeting of the American Association. He prefaced his paper by saying that the strictures upon the mercurial thermometer should not be carried too far. It has been of great value, though it may now fail to meet new demands. Electric thermometry is receiving especial investigation at the signal office, particularly from the meteorological stand-point, with some promising results. Prof. Mendenhall reported the progress which had been made in the study of atmospheric electricity during the past year. It is not time to begin to think of the origin of atmospheric electricity. The problem is its distribution and the relation, if there be any, to weather changes. Some very interesting results have been reached. In ordinary weather the electrical condition is undergoing constant and rather wide variations, which are very local, as two collectors only a few feet apart may give curves differing considerably, though similar in their wider variations. When an electrical storm occurs, the curves over a wide area may be similar in general outline.

Prof. Mendenhall also noted a phenomenon entirely new to him; namely, that resistance coils, after a current is passed through them for some time, upon short-circuiting, will yield a reverse current for hours. This phenomenon can no doubt be classed under the general head of polarisation, yet by simple polarisation it would be difficult to account for persistence of current. This makes caution necessary in the use of resistance coils, in order that any effects of this kind may be carefully noted. In one instance the apparent resistance of a coil was found to increase fourfold when the current was reversed.

AN ELECTRIC BOILER ALARM.

AT the first meeting of the Electrical Section of the American Institute (formerly the New York Electrical Society) a paper was read by Mr. J. J. Ghegan, of Newark, N. J., who described an ingenious and practical method of giving an alarm for low water in steam boilers by means of electricity.

The instrument depends for its operation upon the action of induced magnetism, in connection with the well-known fact that the action of the magnetic force is not impeded by the interposition of non-magnetic substances.

The accompanying illustration, fig. 1, shows the instrument complete as it is attached to the water gauge. Figs. 2 and 3 show a rear view of the device with the cover removed.

According to the description of the *Electrical World*, it consists of a brass case, C, which is attached to one of the side rods, B, of the water gauge of a boiler. Through the upper and lower end of the brass case there pass the legs of a horseshoe magnet, M, the ends of which project a trifle beyond the glass tube, A. The case, which can be adjusted to any desired height, is so placed that the upper leg of the magnet shall come opposite the float, F, when the water is at its normal height. The float consists of a short piece of iron covered with rubber and vulcanised at a high heat.

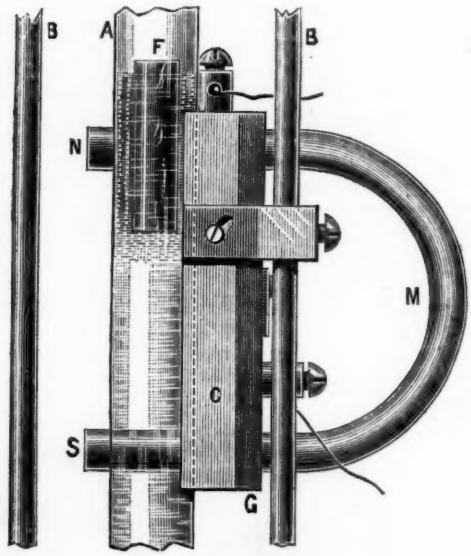


FIG. 1.

Within the case there is pivoted the strip of iron, I, which carries at its centre a platinum pin, D, and attached to the inside of the insulating cover, G, is a small platinum contact, E. The latter is connected to the binding post upon the cover, and another binding post is in electrical connection with the brass case, C; to both these are attached the wires having a battery and call bell in circuit.

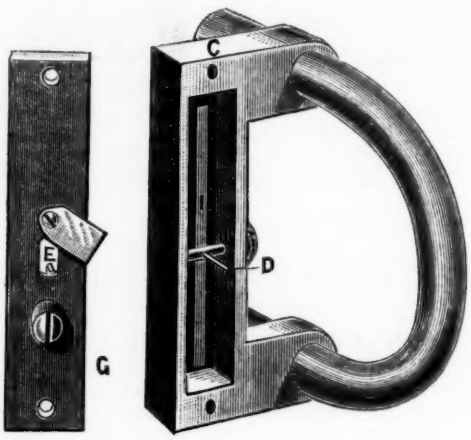


FIG. 2. FIG. 3.

The action of the little instrument will now be readily understood. So long as the water remains at its proper level, the iron, being temporarily converted into a magnet by its proximity to the pole of the magnet, M, attracts the upper end of the iron strip within the case and maintains the pin, D, out of contact with the electrode, E. When the water sinks, however, so

that the float comes opposite the lower leg of the magnet, the iron in the float attracts the lower end of the iron strip against the wall of the brass case, and at the same time brings the pin, I, in contact with E. This closes the electric circuit and rings the bell to give warning of the fact. When the water rises the float follows and opens the circuit again.

Mr. Ghegan stated that having a way of closing an electric circuit at the proper time, we are thereby enabled not only to ring a bell, but also to operate any suitable electrical or electro-mechanical device. With the circuit-controlling apparatus just described it is entirely practicable to automatically keep the boiler properly supplied with water. All that would be necessary is the addition into the circuit of a magnet which should open a valve and start the pump when the circuit is closed; and when the float with the water rises to its proper level the opening of the circuit would be followed by the closing of the valve.

JUDGES AND PATENTS.

MR. JOHN IMRAY has now returned from the Continent, and has recorded in the *Times* his reply to Prof. Silvanus Thompson's last communication upon this subject in the following words:—"On my return from the Continent I find that Professor Silvanus Thompson has, in your columns, added another item, considerable in volume if moderate in weight, to the controversy in respect to judges, experts, and patents. A large portion of the learned professor's letter as to alleged anticipation of Edison's invention by Reis and others is a mere *réchauffé* of evidence which was tendered in the courts, but which failed to 'bamboozle' the judges who had to deal with Edison's patent. When not one judge, but half a dozen judges, who are not so easily 'bamboozled' as Professor Thompson seems to think, have decided all in one way as to the effect of certain evidence, the public may suspect that the 'bamboozled' individual is the professor who dissents from them. The question really is how to construe a patent claim for a new combination, and how far such a claim can be evaded by varying the constituent parts of the combination, the functions and effects of these parts remaining the same. Let us take a simple illustration. In very early times it occurred to the peasant Alva to yoke his ox to a wagon for the purpose of transporting loads. The invention, which was new, turned out to be most useful, and consequently a second peasant, Theil, yoked his ass to a cart, and a third peasant, Bassan, yoked his horse to a gig. Alva naturally complained that his rights were invaded; he claimed as his invention 'in an appliance for transporting loads the combination of an ox with a wagon, substantially as described.' The patriarchs to whom he appealed decided that his invention was in substance the combination of an animal that could pull, be it ox, ass, or horse, with a vehicle that could be pulled, be it wagon, cart, or gig, much to the disgust of the medicine man Silvan, who loudly proclaimed in the gate that the patriarchs had been 'bamboozled.' Professor Thompson, in his remarks on the microphone, virtually admits my proposition. He does not dispute that there is a closed electric circuit partly consisting of a tension regulation, whether that be of imperfectly conducting material or of conducting material disposed in an imperfectly conducting condition; nor does he dispute that there is something which vibrates to sound pulses and acts by its vibration on the regulator, whether that something be a diaphragm or a more or less loose part of the regulator itself, such as the French nails or the bits of carbon or links of the chain. If, instead of separate pieces, whether nails, chain links, or bits of carbon, there was but one piece of any of these materials, there would no longer be a combination of something that vibrates with something that is caused by the vibration to vary conductivity, and there would be no longer a microphone. The professor does not venture to discuss the passage in Edison's specification to which I referred in my former letter, where the diaphragm, a disc covered with plumbago, forms part of the tension regulator, the other part being a button of plumbago which bears against the disk, just as some of the nails, links, or bits of carbon of the microphone bear against the others."

Prof. Silvanus Thompson has returned once more to the charge, and replies to the last letter of Mr. Imray in the following terms:—"I perceive that Mr. Imray abandons solid argument for parable, but, even in this new departure, cannot lay aside the habit of omitting awkward facts. It does not require much discernment to discover in the 'peasant Alva' of his parable, who is alleged therein to have discovered the principle of conveying loads in carts, the inventor Edison, who is thus made to figure as the first to transmit speech electrically. That was indeed Mr. Justice North's alleged reason for stretching Edison's patent, it having been carefully instilled into the judicial ear by Mr. Imray and other eminent experts that the earlier telephones of Reis and of Graham Bell either were never invented at all, or, if invented, were useless. Still, facts are facts. The language of parable is doubtless very convenient when, under the figure of a patriarch who decides that an ass is an ox because it can draw a load, one can discern a certain learned judge who recently decided that a tube was a diaphragm because it could transmit vibrations. But, sir, to return from parable to science. Mr. Imray quoted, *apropos* of his new definition of the microphone, a passage from Edison's specification about a diaphragm covered with plumbago; and now he expresses surprise that I have not discussed it. But I showed that Mr. Imray's definition itself was both incorrect and misleading. I, for one, cannot accept the implied proposition that because in one place Edison described a diaphragm covered with plumbago, therefore, everything that is covered with plumbago is a diaphragm. Such a dictum would not be the less absurd even if, under Mr. Imray's advice as an expert, six judges should so decide. Finally, to sum up the whole question, I have pointed out that there exists a practice of judicially stretching patents so as to make them include more than the inventor claimed, and I maintain that such a practice is essentially unjust. Mr. Imray admits the practice, and defends it in the case of what he calls fundamental inventions. Professor Forbes has explained how the machinery of the courts is such that wealthy owners of patents can avail themselves of this practice to crush inventors of small means. I have also pointed out that there exists a practice in the law courts of representing a mere improvement in detail to be a fundamental invention, in order to gain the advantage of having the patent stretched. This also Mr. Imray does not dispute, but retorts that the opinion of a mere professor is not worth that of six judges. When I narrow down the issue to particular cases he tries to evade the issue by coining definitions that beg the question and parables which omit the facts. I submit, then, that my main propositions remain unshaken, and in closing this discussion I can only thank Professor Forbes and Mr. Imray, whose letters have respectively helped to expose and illustrate this blot in the administration of patent law."

LAMPS WITH CARBON FILAMENTS.

WE extract from the *Bulletin de la Société Belge d'Electriciens* the following letter from the pen of M. Somzée:—

Brussels, *August 12th*, 1886.

Mr. President:—

Not being able to pass over in silence the communication made by M. Emilé Picard to the Belgian Society of Electricians, I venture to address to you herewith a table intended to serve as an answer to the said communication.

This document, arranged on the basis of a comparison

of the patents which form the subject of the suit, being fairly explicit, I shall confine myself to pointing out the principal errors put forward in the formal opinion forwarded to your society.

I may be permitted to show that M. Picard acts here as a patent agent defending the interests of his client, and that there is thence room to lay more weight on the enlightened opinion of the learned engineer, M. Evrard, absolutely disinterested in the question.

The tactics of M. Picard show genuine skill, placed at the service of the most commendable intentions, which I do not hesitate fully to acknowledge.

M. Picard, acting as an excellent patent agent, seems chiefly occupied in finding means suitable for disentangling the patent of his client, Mr. Edison, from the eventualities of judicial proceedings of the kind of those unfolded before the High Court of Justice of England, and he visibly strives to place this patent outside the case by avoiding to show its analogies with that which I filed November 5th, 1879.

To this end, M. Picard, wishing to connect my invention with a prior arrangement of Edison's, takes his stand upon the coexistence on the one part, and upon the other of a hydrothermic regulator, certainly indicated in my patent, but *as a means to be employed only in case we wish to return to the use of metallic spirals.*

This specification is strictly precise, and permits of no doubt as to the limitation which I have meant to formulate on this point.

The term of comparison selected by M. Picard, therefore, does not bear examination, and there finally remain before us for Edison's patent of November 9th, 1878, merely a lamp with a twisted platinum wire, and for Somzée's patent of November 5th, 1879, a lamp with a carbon filament, bent in the form of a horse-shoe.

There is, therefore, no identity possible between my invention and the only one which M. Picard has sought to oppose to it with the advantage of priority, and we comprehend the importance which this unsuccessful attempt at identification gives to the Somzée patent of November 5th, 1879, as against the Edison patents of November 21st and December 30th of the same year.

M. Picard, moreover, is willing to admit that M. Somzée was the first to claim the application of a carbon filament, which is something; but he adds that M. Somzée says nothing of the thickness of the filament, which to his (M. Picard's) mind is the essential point.

But, although it is self-evident that in speaking of a filament there can be question only of a thread of the utmost tenuity, M. Picard takes advantage of the circumstance that the thickness of the filament is not mentioned to raise a doubt as to whether it can furnish a burner of great resistance, though this quality appears distinctly from the precise indication which I have given as to the luminous power of my lamps when placed in a variable number in a single circuit.

Further, to suit the requirements of his case, M. Picard omits to mention the precise indication which I give of a novel result indicated in my patent, and this omission bears the more distinctly the mark of an evident intention, as this very result must constitute an unquestionable character of patent ability in the eyes of M. Picard, the author of a remarkable treatise on patents for inventions.

There is a matter which M. Picard does not forget to reproduce, but, be it understood, with exaggeration; that is, the width of the carbon filament traced in the text of my patent; in this same patent which, indicating in a precise manner the illuminating power of my lamps, proves plainly that there is here question of a filament made to fulfil the conditions of a high resistance.

Whilst showing himself so captious on the subject of the specification of the thickness of the carbon, M. Picard seems to me to have overshot his mark. I am about to show that Edison's champion, without touching me, strikes his client full in the breast.

Without proving anything as far as I am concerned, he gives me the opportunity to remind him of the dimensions which Edison himself assigns to his filament in his specification of December 30th, 1879, in the drawings of which these filaments are figured as two millimetres in breadth by more than one millimetre in thickness, with a very slight development of the incandescent part.

But it is upon the specification of this filament of more than two square millimetres in section that Edison would found his claims and his pretensions to block completely electric industry.

Let M. Picard beware; it is he who has carried the discussion into a region full of dangers for his American client.

However this may be, since light is about to dawn on this important question of the general priority of the lamp which has furnished the solution of the problem of the divisibility of the electric light, it is important to know what is up to the present date due to all parties.

It is enough to read Edison's patents taken at the end of the year 1879, to be certain that they are not connected with his former experiments.

In fact, in his patent of November 29th, 1879, Edison thinks it needful to specify anew an incandescence lamp composed *of a spiral (this time of carbon) presenting a great resistance;* the combination of this carbon-filament in a receptacle made entirely of glass in which terminate the conducting wires; a filament or a coiled band of carbon arranged in such a manner that only a part of the surface of this carbon produces the radiation of light. It is not until December 30th, 1879, that there occurs to Edison the resisting filament of carbon bent in the shape of a horseshoe, with an arrangement at its extremities to receive the connections.

Then also comes the question of the carbonisation of the filaments; but we know that this operation may be effected in different manners and that it has furnished matter for numerous patents.

But all the constituent features of the Edison patents of November 29th and December 30th, 1879, form the subject of *my single patent of November 5th of the same year*, that is to say:

A filament of very pure and dense carbon curved in the form of a horeshoe with an attachment at its extremities, and placed in a globe of glass so as to insulate *completely the carbon and to withdraw it from any oxidation.*

Thus, whatever M. Picard may think, the points of resemblance between my invention and the subsequent ones of Mr. Edison are numerous, and the analogies bear certainly upon the essential characters found in all lamps made at present.

On the other hand, the data of the Somzée patent, as regards the qualities of the burner and its yield in light, are complete; in effect I state in this patent that such a lamp would be equivalent to about 20 candles, several lamps mounted in series in a single circuit. This is not the case with the data furnished by Edison, which are absolutely incomplete. Why say more?

Whilst breaking a lance bravely on behalf of the interests entrusted to him, will M. Picard have succeeded in upholding them in this matter? We may venture to doubt it. Was not M. Evrard justified in saying that Somzée had given the complete programme of the conditions which an incandescence lamp ought to fulfil; that he had given the principal arrangements, and that the apparatus described in his patent taken out 16 days (24?) prior to that of Edison, includes all the elements of a good incandescence lamp?

I shall feel obliged to you, Mr. President, for kindly inserting this reply in the next number of your *Bulletin*, and I beg you to accept the assurance of my most distinguished consideration.

Telegraph Revenue.—The receipts on the telegraph service from April 1st to September 25th, 1886, amounted to £840,000 against £935,000 received from April 1st to September 26th, 1885.

A HUNDRED YEARS AGO.

THE date September 20th is memorable in the history of electricity, and the most important in the life of Luigi Galvani, who may be called the prophet of motive electricity.

It was, in fact, on the 20th September, 1786, that the illustrious professor of the University of Bologna arrived at the momentous discovery from which spring the applications of dynamic electricity. In order to study the influence of atmospheric electricity on the movements of the frog in calm weather, Galvani prepared one of these animals in the usual manner, and then having passed a small copper hook through the spinal marrow, he suspended it to the iron balustrade which surrounded the terrace of the Zamboni Palace which he then inhabited. He had already tried the same experiment several times without obtaining any result. Again and again he ascended the terrace to note, hour by hour, if anything might happen. At the end of the day, wearied with the tediousness and the inutility of his observations, he took hold of the copper hook fixed in the spinal marrow of the frog and applied it to the iron railing, which he rubbed briskly with the hook as if to render the contact between the two metals more intimate. Immediately the lower limbs of the animal entered into contraction, and these muscular movements were reproduced on every fresh contact of the copper hook with the iron balustrade. The weather, moreover, was fine, and nothing indicated the presence of free electricity in the atmosphere.

The fact observed on the terrace of the Zamboni Palace was the most important, the most fruitful of all those which Galvani had discovered since the origin of his studies ; it was the lamp which shone in the night of the obscure phenomena whose darkness he had for six years sought to dispel.

Up to 1791, Galvani, engaged for 11 years in experiments executed without cessation, had still not given any exposition of his labours to the scientific world. Only after this long interval he decided on publishing his ideas. He committed the totality of his discoveries to a work which is a miracle of clearness, of precision, and of method, and which has been inserted in the memoirs of the Academy of Sciences of Bologna.

Luigi Galvani, physicist and physician, was born in Bologna in 1737, where he lived and where he died in 1798.

He devoted himself with eagerness, genius, and learning, to profound speculations in the field of electric science, and it has been proved how rash and gratuitous was the assertion of Arago, repeated subsequently without limit that mere chance and not genius and the spirit of observation had been the cause of his discovery.

It has been said and repeated many times that Galvani did not know how to recognise the nature of the phenomenon which manifested itself for the first time to his eyes. It is held that he, an excellent anatomist, but an ignorant physicist, did not comprehend that the contractions of the frog were due simply to the counter-stroke, and that he had thus been led to immerse himself in a multitude of researches which he would have avoided the trouble of undertaking if he had been a good physicist.

To accuse Galvani of being ignorant of the elementary facts of static electricity, is to commit a real injustice. The anatomist of Bologna was acquainted with the phenomenon of counter-stroke since he has spoken of it in his works. He had, further, made numerous experiments on electricity produced in a vacuum on the Leyden jars exposed to the influence of the electrical machine. Such studies suffice to prove that Galvani possessed a solid knowledge of static electricity, and that he could not have been ignorant of the phenomenon of the counter-stroke.

At Bologna there has just been erected a monument, the work of the sculptor, Adalberto Cencetti. The attitude, the expression of the face, and the study of the costume render it a valuable work of art.

The Bolognese have further commemorated their illustrious fellow-citizen by a stone placed at the house which he inhabited, the inscription on which runs :—

"*Luigi Galvani.*—In this house—his temporary abode—in September, 1786—discovered in a dead frog —animal electricity—a source of wonders—to all ages."

Of wonders, and we add of well-being, of power, of prosperity for us and for nations to come who will always remember the name of Galvani with gratitude when they think on the prodigies of electricity, by means of which the speech of man now knows not distance.—*Il Secolo.*

THE BRITISH ASSOCIATION.

(*Specially Reported for the "Electrical Review."*)

COMPARISON OF HARCOURT AND METHVEN PHOTOMETRIC STANDARDS.

By W. STEPNEY RAWSON, M.A.

(*Section A.—Mathematical and Physical Sciences.*)

Monday, September 6th.

PERHAPS no subject has received greater attention during the last few years than that of light and lighting in general.

Public and private lighting have received an impetus which is gaining in strength every day.

The competition of the electric light has done an enormous amount of good in opening the eyes of the public to the defects of the old methods and the necessity for new.

Where a few years ago we could have found only a few persons who had any practical knowledge of photometry we now find hundreds—we have boys and girls making accurate photometrical tests by thousands every day in the manufactories of incandescent lamps—we have the leading scientific men of the day devoting themselves to the comparison and analysis of all kinds and quantities of light, and yet when we are asked by what standard is light measured and what is the meaning of a candle-power, how completely unsatisfactory is the answer.

It is true that many text books give full particulars of the various standards of light and the relative values which the standards in different countries bear to one another, but who is there bold enough to assert that an expert in Berlin will give the same value to a particular light as one in Paris or London ?

And this unsatisfactory state of things is not due, as many think, to the fact that one observer's eyes are not the same as another's, for if two skilled photometrists meet for the purpose of comparison they probably find that their personal error is an extremely small quantity.

But we may confidently assert that the variations are mainly due to the absence of the necessary standard, which in the case of weight, length, time, and heat are permanently fixed.

Science has not been idle in its attempts to settle the question, and many are the methods proposed as a solution of the difficulty, some feasible, others eminently impracticable, but government authorities alone can settle the question for each country, and to them we naturally look for information.

And here we are immediately brought face to face with the anomalous state of things that the government standard as at present fixed is absolutely the last which any experienced person would adopt except under legal compulsion, and instead of it we find various standards recommended and adopted according to the requirements of the work to be done.

Having been for a considerable time engaged in the measurement of the light of incandescent lamps and other sources of light at the factory of Messrs. Woodhouse and Rawson, at Hammersmith, in London, it has been of the utmost importance for us to procure a perfectly reliable standard by which we may determine the correct electromotive force which should be supplied to the various types of lamps made by them to produce the normal candle-power at which the lamps are intended to be used.

It may, therefore, be of interest to those of you here present who are technically acquainted with the subject, and also to others, if I put shortly before you our experience of two of the standards at present employed in work of this kind. The result of a committee appointed by the Board of Trade in 1881 to report upon photometric standards was to bring prominently into notice two standards, viz., the Harcourt air gas lamp and the Methven screen.

These two I have here on the table, and it is with regard to them that I wish to speak to-day.

Description of Methven screen and improvements made in the Harcourt lamp since last meeting of the British Association.

Having both standards in our possession, it was naturally a matter of some interest to compare the two, and a considerable time ago we made a rough comparison of them, but about eight months ago my colleague Mr. W. F. Donkin and I commenced a

series of experiments to determine the exact comparative value of the two, and to find the extent and probable cause of the variations observable in the Methven screen.

The report of the above-mentioned committee on photometric standards stated with regard to this standard that "where there is not any liability to a greater alteration in the quality of the coal gas than about two candles the ease and rapidity of this system may render it extremely useful in determining the illuminating power of gas" (or other sources of light), "but the lamp in its present form has not that exactness for such a range as is necessary for a standard of light." In other words, the report stated that this was a fair commercial standard for employment in places such as London, where the normal variation of the value of the gas does not exceed two or three candles.

As there was at that time a great demand for such a commodity owing to the great inaccuracies of measurements by standard candles (which errors are very well set forth in the above report) the Methven screen was taken up as a distinct advance upon the time-honoured "Parliamentary candle," and rapidly came into general use.

Since then it has found its way largely to America and the Continent, and we believe has lately been supplied to the Canadian Government.

In its original form the standard was so constructed that the centre support was in a vertical line with the screen, and from this point all measurements of distances were made.

The instructions now issued with the standard state that the measurements "are to be made from the centre of the burner, which position in a 60-inch Letheby photometer is 30 inches from the centre of the graduated bar."

Now these instructions certainly lead to the conclusion that the standard is fitted for employment in a Letheby photometer, and as ours is of that pattern we should expect to obtain good results with it.

Our earlier experiments were made with a bar of 80-inch length but as we wished to work at greater distances we had a new photometer constructed with a bar of 144 inches, in which great care was taken to verify all measurements.

In addition to the ordinary bar graduated in candle-powers, we have a brass bar divided into 10ths of an inch, which enables us to take readings by estimation to 100ths of an inch.

At first the Methven screen was fixed at the right-hand end of the bar, and the Harcourt lamp was mounted upon a carriage which moved in the same grooves as the disc holders; in our later experiment these positions have been reversed. The position of each was very carefully determined at the commencement of each test, and the chimneys were scrupulously cleaned—an important point too often overlooked.

The table is so marked that the carriage can be placed at any required point with great exactness—the distances between centres which we usually have employed are multiples of 10 inches from 20 inches to 120 inches.

It was only necessary, therefore, to place one standard at any required distance from the other and then take a series of readings, from the mean of which we could calculate the value of one in terms of the other.

We have always taken the value of the Methven in terms of the Harcourt as unity. Both standards were carefully watched by one observer through blue glass for the sake of his eyes, while the other took his readings; by this we guarded against any change taking place in the heights of the flames and causing an error in the readings.

The constant flickering of the flame in the Methven standard makes it difficult to determine accurately when the flame is at the right height, and this may constitute a source of error, as we have found a change taking place in the quantity of gas passing, and consequently in the value of the light when the eye was hardly able to detect a change in height of the flame.

At first we worked with a Harcourt lamp without a chimney, and we were obliged to be very careful to exclude draughts, as the height could not be accurately determined unless the flame were steady, but latterly we have used the form which you see here, and the flame of this is absolutely steady and no difficulty arises on this ground.

The earlier values found for the Methven were so far below what is given as its normal value, viz., two candles, that, as we had originally obtained a certificate of its correctness, we thought some change had taken place, so we sent it to the makers asking them to verify its correctness, and it was returned to us with the value 1·98 or 1 per cent. below normal. At the same time we verified the accuracy of the Harcourt by comparison with the official standard at the gas referee's office, and it was found to be correct within the limits of skilled observation.

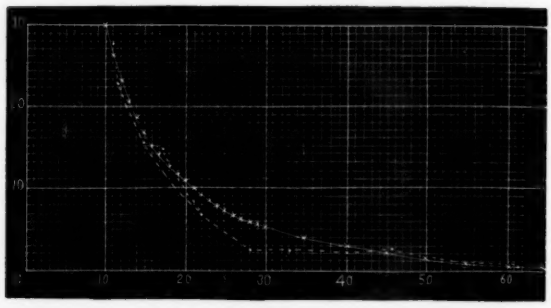
I may state that this standard had been carefully compared two years previously with Mr. Harcourt's standard at Oxford, and had been found by him to be correct. Now I think you will not have much difficulty in seeing that with this form of the Methven standard, as the disc in a Letheby photometer recedes from the screen, the light falling on the former will gradually decrease from a cause totally different from that known as the decrease according to the law of the inverse square of the distance.

To explain this, I would ask you to think of the case of looking through a loophole in a wall at the country beyond; as you come nearer to the opening more and more of the landscape appears, while if you recede from it the view contracts gradually till at last a further movement makes little or no difference to the amount seen through the opening.

The disc, then, represents the observer's eye, and the luminous flame is in place of the country seen beyond.

This objection applies equally to all standards which employ what is known as the slot method, unless the slot is so close to the flame as to be practically coincident with it, or the measurements of distance are made from the slot, as in the original form of the Methven. It may be shown mathematically that the diminution of light due to this cause does not depend upon the size of the slot, but only upon the distance of the slot from the flame, whereas if measurements are made from the slot and the light behind can be regarded as a flat homogeneous flame, the law of inverse squares holds as rigidly as with a naked flame.

I have on this diagram the theoretical curve of variation determined from the measured distance in our standard of 1·4 inches between the slot and the centre of the flame, which may be regarded as the mean position of the luminous source. I have also marked the mean curve deduced from a number of observations made by Mr. Donkin and myself.



THEORETICAL CURVE OF VARIATION OF METHVEN STANDARD.

Abscissæ 1 division = 1 inch distance of disc from Methven.
Ordinates 1 division = 1 per cent. rise upon value at 65 inches.
* * * points on theoretical curve.
o o o points on observed curve.

In order to show the curve more plainly, I have taken for abscissæ the distances of the Methven from the disc, and for ordinates the rise per cent. of its value above that which it has at 65 inches from the disc, which is the point where the curve becomes practically a straight line. The second curve is the mean of values observed between February and April of this year, and though by no means perfectly agreeing with the theoretical curve in some places, yet the discrepancies are small, in no case being more than 3½ per cent., and in some cases less than 1 per cent.

The curve shows, I think you will agree, that a considerable rise, amounting in one place to as much as 25 per cent., takes place in the value of the Methven as the disc approaches it.

On one occasion we investigated the point as to whether the light is absolutely constant even when measurements are made from the slot.

We found, as others also have, that a slight increase takes place as the disc approaches, due to the greater thickness of flame subtended by the disc. The values on every occasion were taken with the wire of the Harcourt set at 2½ inches, and the proper reductions made according to the formula established by Mr. Harcourt for changes due to alteration of barometrical pressure, viz., that wire must be set ·2 mm. higher or lower as barometer is below or above 30°. In order to satisfy ourselves still further as to the existence and amount of the variation at different distances we employed the following method:—An incandescent lamp was made with two filaments, so that either could be run separately or both at once, either in parallel or in series.

These were made of different sizes, so as to give three different amounts of light according as one or the other or both were run. If a perfectly constant E.M.F. be maintained at the terminals of the lamp the light emitted by the two filaments together should be the sum of the lights of each observed separately.

But it will be plain that if the above variations exist, the observed sum when using the Methven as the unit of light will be less than the true sum, because the value of the Methven is greater at the shorter distance of the disc from it. We found as was to be expected, that this was always the case, but we made a more rigorous test of the accuracy of the theoretical curve by taking the theoretical values for the longer distances corresponding to the values of the lights from the filaments observed separately, and then deducing from the observed sum the real value of the Methven at the distance corresponding to the sum of the lights. This value should, of course, be the same as the theoretical value at that distance.

By properly choosing the E.M.F. this method could be employed to establish the variation over the whole range of the bar.

In order to keep the E.M.F. perfectly constant secondary batteries were employed, and any minute variations noted by a Thomson voltmeter and connected by an adjustable resistance in circuit, one observer noting voltmeter and controlling resistance. A delicate ammeter in circuit was also used to check the accuracy of the current passing when both filaments were run together, being equal to the sum of the currents observed with each filament separately.

The result of three carefully made series of tests with different E.M.Fs. gave us a mean deviation from the theoretical curve of less than 1 per cent.

The lamp was so arranged that it was not moved during the tests, and the contacts were all made by mercury cups except at the terminals of the lamps which were carefully cleaned and clamped by broad pieces of metal.

I have quite recently made a fresh determination of our earlier results, as I found that the disc we had employed had become slightly tinged with yellow by atmospheric action, which would give us results slightly in favour of the yellower of the two lights. These determinations have been made nearly continuously during the month of August, and I have, unfortunately, been deprived of the assistance of Mr. Donkin, who has been absent during the time, but I have generally had the help of a qualified person in determining the setting of the distances and other details.

A small change in the construction of the photometer necessitated a reversal of the positions of the standards, the Harcourt now being at the right hand end of the bar and the Methven mounted upon the movable carriage.

The results at first were manifestly incorrect, and I soon found that this was due to reflected light from the large body of light in the argand flame, which, in spite of black curtains for sides and back ground, threw sufficient extra light upon the disc to render the results plainly wrong.

In our earlier experiments this was prevented by a large fixed screen in front of the Methven slot. The difficulty was easily cured by placing perforated screens on each side between the disc and the standards, allowing only direct rays to fall upon the disc. In spite of this I was unable to obtain results over the whole scale at all comparable in uniformity with our previous readings.

The value of the Methven was far lower than could be accounted for by the change of disc, and it was impossible to obtain concordant results extending over a period of four or five hours.

Portion of the readings would be fairly correct, and then a deviation would take place from the theoretical curve, and on returning to a previously tested position a change would be found to have taken place. I therefore obtained a meter of the well-known makers Sugg & Co., in order to test the quantity of gas passing with a 3 inch flame and also the total light given by the flame with the normal 5 feet of gas.

I found to my surprise that 5·8 feet were required to produce a 3 inch flame—this is 16 per cent in excess of the normal—also the total light of this flame was on August 2nd only 15 candles, whereas it should be 16 candles with 5 feet. But on August 28th, at 4.30 p.m., I tested the amount of light with a 3 inch flame consuming 6 feet of gas, and also with 5 feet of gas passing.

I found the former only 13·2 candles and the latter 9·2 instead of the normal 16. This probably was the cause of the inaccuracies in my later readings, for though the Methven is practically constant for small variations of quality of gas above and below the normal, yet when the quality is so far below normal as I found it, it seems to be remarkably sensitive to small variations in quality such as are constantly occurring. I can only suppose that in the winter months we were fortunate in obtaining gas of a tolerably constant quality during our experiments, although from the low value of the Methven I think it must have been considerably below normal.

I have been informed that deposition of heavy hydrocarbons in the service pipes causes a serious diminution in the quality of gas reaching a consumer, especially if he, like ourselves, has the misfortune to be at the far end of a long service pipe and something like four miles from the gas works, so that I can hardly suppose that a sample of gas taken straight from our main in the Hammersmith Road would produce such poor results; but however that may be, we have obtained exactly the conditions in which the above-mentioned committee foresaw so much danger in a standard founded upon the consumption of gas, which is subject to considerable variation.

I think that I have sufficiently pointed out the difficulties we have encountered with this standard, and I have only to add that in its present form it is obviously faulty; and even if it were altered back to its old form and measurements made from the slot, it would be still unreliable unless a constant check could be kept upon the quality of gas passing through it, and allowance would always have to be made for the variation due to increased thickness of flame, as mentioned before.

I am only expressing the opinion of those who have any acquaintance with the Harcourt lamp, when I say that a three years' experience of it as it has developed its practicability and handiness and increased its accuracy by the employment of a reduction table for barometrical changes, enables me to say with perfect confidence that though, perhaps, it may not be the ideal standard of white light of which we are in search, yet it is a unit of light which is practical in construction and adjustment, and as regards its extreme accuracy is well worthy to be classified as a recognised standard unit.

ELECTRIC LIGHTING AT CANNOCK CHASE COLLIERIES.

By A. SOPWITH.

(Section G.—Mechanical Science.—Monday, September 6th.)

THIS paper must be considered as merely introductory to a visit which is proposed to be made by members of the Section to the Cannock Chase Colliery, and deals in a general way with some special advantages and economies in connection with the electric lighting of collieries.

The author points out the convenience and economy in utilising the ventilating fan engines for working dynamos, on account of the regularity of speed (which apart from the requirements of an installation is kept within a limit of 1 to 3 per cent., such variation being a gradual diminution or increase) and the fact that such engines run continuously night and day. The fan itself acts to some extent as a regulator, as the tendency to run away on switching out of lights is modified by the increasing resistance of the air; *vice versâ* the putting on of load and consequent tendency to slacken speed is reduced by the diminished work done by the fan at a few revolutions less; again the comparatively small proportion of power required for working dynamo, amounting to from 7 to 12 per cent. of the usual working power of engine, may be considered an advantage.

The addition of counter-shafting in cases of slow running fans, or single pulleys in case of quick running fans, is an easy and inexpensive matter.

Allusion is made to the small extra consumption of coal in practice, and the merely nominal value of the slack which is consumed. In further connection with the working expenses, viz., replacement of lamps, it is mentioned that the underground workings in vicinity of shafts (extending to 200 or 300 yards) admit of lamps being worked considerably below power with sufficient effectiveness, and actual lives are given (including breakages) showing at one pit an average of 2,270 hours. The men who are required to act as examiners of machinery, and have no specifically regular work to do otherwise, replace lamps, and can attend to any occasional work connected with the installation. As a matter of fact, the three installations now working at Cannock Chase have not necessitated the employment of an extra man.

The only original feature—at least the author presumes it to be so—is the utilisation of old iron and steel pit ropes for main and branch cables. From four to five miles of rope are worn out annually, varying from ⅜ inch 1¼ inches diameter and over, and the conductivity of this has been proved to be about one-seventh that of a copper cable (of high conductivity) of similar dimensions. In the case of shafts, in order to avoid the injurious effects of water, the ropes are encased in wood boxes strung down the side of shaft and roughly insulated on brackets. Underground, one of the ropes is simply wrapped with old brattice cloth or tarpaulin. On the surface the ropes are laid in brick channels filled in with gas tar and coal dust, but it appears from the last trials that it is sufficient to lay the ropes side by side in the same material; there is no appreciable loss of current. The fact that old ropes are only worth a few pounds per ton enables a profuse use of cables to be made, and at one of the installations the current is conveyed a distance of nearly 1,300 yards (double distance) with a resistance of only ·05 ohm, nearly one-half of which is due to the insertion of a length of $\frac{1}{9}$ high conductive copper cable.

A brief description of the last installation—which includes lighting of all surface works (extending over five acres), the underground workings in vicinity of shaft, and, at a distance of 620 to 700 yards away, the church, schools, and houses—is given.

The author remarks upon the practicability of economical extension of installations by utilising old material such as ropes, old rails, water and gas mains, and gives the resistance of the latter as tried in one case, and concludes with a few general remarks.

DISCUSSION.

Mr. PREECE asked if Mr. Sopwith had drawn any comparison between the cost of using the electric light and the cost of gas.

Prof. GEORGE FORBES remarked that Mr. Sopwith stated that the lamps which were in continual use lasted 3,000 hours, and the lamps which were switched out occasionally only lasted 1,300 hours. This astounding statement was followed by a modification which suggested that the difference might not be actually so great as the figures seemed to indicate. He (Prof. Forbes) would like to ask if Mr. Sopwith could give any definite information upon the point. It was of the utmost importance to find out if there was anything approaching such a difference. Hitherto such a difference had been occasionally spoken of, but up to the present time there was no evidence forthcoming. There was one thing to be noticed, in making a comparison of this kind you must be sure that the difference is not due to greater length of leads in the case of the lamps continuously lighting, causing them to be burnt at lower incandescence. He hoped the effect of this paper would be to bring forward information of a totally new kind in reference to the life of lamps.

Mr. PREECE said he had had the pleasure of going down into the collieries with Mr. Sopwith, and he could testify to the admirable way in which the whole thing was carried out.

Mr. SWAN expressed the gratification he felt to find electric lighting in collieries carried out to the extent shown in the paper, and with so much skill and practical knowledge of what was wanted.

Mr. SOPWITH, in replying to the discussion, said with regard to the relative cost of electricity and gas, he had not mentioned it in the paper, but had rather kept it in the background, partly because he thought that in a paper of that sort a complete analysis of the comparative cost ought to be very closely gone into. So far as his practical experience with gas was concerned, especially

of late years, it had been at the colliery itself, and the gasworks there, in consequence of a subsidence of ground and their age, were in such a state that the comparison could hardly be called a fair one. He estimated the saving as compared with their gasworks at nearly £500 a year. But taking gas at 2s. per thousand feet, the difference would amount to about £150 a year for 600 burners. He should like to carry out the calculation in a much more detailed way when he dealt with it. He might mention that the whole of the work was carried out by colliery workmen. The conditions generally were exceptionally favourable, and it would scarcely afford a satisfactory answer to the broad question whether gas or electricity was the cheaper means of lighting. In answer to Prof. Forbes as to the life of the lamps, he might, perhaps, have put the point a little more definitely if he had read from his MS. instead of making abstracts from it. The paragraph in the paper relating to the average life of those lamps which had been burning continuously compared with those switched out daily, said that the difference was so great that before accepting it, it would be very necessary to obtain carefully noted results. The lamps which lasted longest were further away than those which showed a shorter existence, and undoubtedly circumstances were in favour of the lamps in the distance. He hoped to have an opportunity of pursuing this enquiry and of getting a fair approximation of the difference there is between continuous burning and constant switching out.

THE ADAPTATION OF CARBON PENCILS TO DIFFERENT CURRENTS IN ARC LIGHTING.*

By G. W. PARKER.

THE vast sums of money that have been, and are daily being, expended in buildings, machinery, dynamos, lamps and other appliances for electric lighting, are expected to return a profit on the investment. This profit, in your case, must be realised from the sale of one single product, and that is light. This product appears and is delivered to consumers at the junction of the carbon points, and however perfect may be the machinery, however well adjusted the lamps, if these points are to any great extent defective, or from any reason unsuited to the currents, the profits are curtailed and your customers dissatisfied.

For this reason the carbon becomes a most important factor in your business of electric lighting, probably the most important, for of your other appliances you have control and can regulate their defects.

The object and purpose of this paper is an attempt on the part of a manufacturer to canvass defects whether on your part or his, to discuss with you the weak points of the methods of manufacture, if any, and to gain from you, if he can, such information as will enable him to apply a remedy if it may seem necessary.

At the outset we are confronted with a fearful array of possible hindrances to a perfect light. On your side we have a want of steadiness in the motion of the engine, irregular action of the regulator, if there be one; weak currents, the mechanism of the lamp not acting with sufficient power, tarnished rods, dirty working parts in the lamp, causing irregular movements, partial grounds on the line, short arcs and heavy currents forming mushrooms in some systems, low currents, leaks around the arc, overloading the circuits, either by too many lights, imperfect joints or solid connections and probably others of which you can better inform me than I can enumerate to you.

On our part we may have impurity of material, imperfect baking, low conductivity, places of higher resistance in certain portions of the carbon, too much or too little plate, lack of coherence and density, lack of hardness for some systems and softness for others, improper selection of material for a given system and possibly others of which we do not yet know.

With this knowledge of the many mechanical difficulties that interfere with the production of a perfect light in the burning of carbons, it is necessary that both the producer and consumer should specifically, and one by one, do all that lies in their power to abate these defects. On your part it is comparatively easy, for most of them are mechanical and simply require constant and careful supervision, while the remainder can be detected by the admirable instruments devised for the purpose which are every year becoming more perfect.

It is but natural that the manufacturer should believe, admitting the many defects that may exist in his carbons, that the imperfect light is in a large proportion owing to the lack of order in the working of your machinery and appliances.

How far this may be the case, neither side is in a position at present in a general way to know; but if in particular cases you could spare the time and would take the trouble to investigate on your side and then report to your manufacturer, with specimens and details of defective action, you would be of great service to him in thus assisting to correct a fault, which would be of final benefit to yourselves.

The difficulty that besets the manufacturer is greater than with you, from the fact that he has but a crude method of detecting differences in his goods. He can be careful as to the purity of his material, can intelligently select the different kinds of material and the different mixtures of them that are designed for the various systems, can see that his machinery is in order, that the carbons are thoroughly baked, and that they are properly plated when it is necessary. When his goods are finished they look alike, seem to be in good order, ring the proper tone in handling, and he has every reason to suppose that he will have an uniformly good account of them from his customers. And so he does, in a general way. All you want is steadiness, a good light and a fairly long life. But you will say of some of them that they flame; of others that they do not last long enough.

Now, the important question is: Whence come these differences? Do they exist in the carbons or do they arise from changes in your currents, and defects in your lamps and other machinery? I admit that this manufacture is a new business, that experience has yet to teach us something; but I have always maintained, and do now, that they can be, if they are not already, made practically uniform. There is no good reason why, that in one hundred carbons that appear to be the same, and of good workmanship, two or three or more should behave differently from the rest.

This should not be the case; on the contrary, they should be uniform; but if it is, how are we to ascertain it before we ship them to you? Can you, from your skill and experience as electrical engineers, suggest any test that can be practically applied, or devise any instrument determining conductivity, resistance, or any other feature that will unerringly tell us when our goods possess such physical or other properties, as will assure uniform behaviour when they reach you?

If you can do this, and it is the essential point that I hope to accomplish by your consideration of this paper, we will gladly adopt it.

On the other hand, I will take the liberty to express the opinion that, as you no doubt know better than I do, it is of the highest importance there should be on your part perfect regularity in the working of all and every one of your machines and appliances. When this is done you can then with certainty place the burden of irregularity, if there be any, upon us. I will even go so far as to say, that it would be to the interest of the owners of the different systems to employ at their own expense, experts to visit their various plants, whose sole business would be to regulate and keep in order such as did not already have skilled electricians in charge.

There is a special phase of the question that occupies an important position, and when I touch upon it, please bear in mind that this paper is not written by an expert in electrical science. It does not propose to teach you anything in that direction, but, on the contrary, its discussion is expected to further enlighten the carbon manufacturer in a practical way as to the relations existing, or that should exist, between your currents and his carbons.

I refer to the different currents of the various systems of electric lighting, and to the varying currents of the same system. The former is, I presume, the result of a difference of opinion among electricians as to the commercial or economic value of their respective currents as applied to the apparatus they have devised for generating them. For the latter there is no reasonable excuse, and it has a prominent place among the causes of irregularity in the behaviour of the carbons before noted.

In the present state of carbon manufacture it is proven beyond question that very slight changes in the current and resistance will require corresponding changes in the structure of the carbon. This, of course, holds good in respect to two different systems whose currents vary but little from each other, and still more where the variation is greater. I am not prepared to assert that we will never make a carbon that will burn equally well in all currents. I do not know enough at present of the causes and effects in their relation to each other, and if you can throw positive light upon them, it will assist us materially to determine the question. It seems incredible that these slight differences in manufacture, which might in some instances be termed almost infinitesimal, would affect the burning of the carbon, and thus determine the system it is intended for, but repeated tests both in actual use and in careful experiments compel us to accept it as a fact.

So far as the different systems are concerned, the manufacture cannot be varied to fit all of them separately. Experience must, as the matter now stands, determine the suitable carbon, and form these systems into certain groups that will use the carbon.

But, for the permitted variations of the same systems no provision whatever can be made by the manufacturer, and the remedy lies only with you. How many of you have meters for the purpose of determing the volts and ampères of your respective currents, and how many of you, having them, require employés to constantly maintain perfect regularity in your currents. You will under any circumstance have some irregular action in the burning of your carbons from this cause, until this is done.

In closing this brief statement of a question of very great importance, I express the hope that its introduction will have the effect to unite the consumer and manufacturer in a joint effort, to determine if it is a fact, that there is any general lack of uniformity in the behaviour of burning carbons, and if so, its cause, so that a remedy may be applied in whatever direction it may be found necessary.

* Read before the American National Electric Light Association, Wednesday, September 1st.

Mr. STEUART suggested that the more experienced members should get together and formulate tests for good carbon points, by which the manufacturer could know whether he was turning out standard

goods that were not liable to come back on his hands on unfair pretexts and at a loss.

Mr. LAW and Mr. DECAMP stated that when they got long-life carbons the efficiency of the dynamo was reduced. The lamps and machine took more power. A long-life carbon was a desideratum, but not in that way.

Mr. PFANNKUCHE being called upon, gave some details in regard to his cored carbons.

ELECTRICITY AT THE SANITARY EXHIBITION.

THE exhibition which was opened on September 21st as an illustrative adjunct of the Sanitary Congress at York, and which will remain open as a popular resort for at least another fortnight, contains several valuable examples of electricity for public and private purposes, and these examples have proved not the least interesting and attractive part of the exhibition. In the first place, the building is illuminated by five arc lamps inside and two outside, and by 60 or 70 incandescent lamps attached to the various stalls and exhibits, supplied by the Woodhouse and Rawson Electrical and Contract Company, Bradford. This installation, which has been set up and carried out by Mr. Allen Scott, consists first of one of the best engines turned out by Messrs. John Fowler & Company, of Leeds, having a pressure of 140 lbs., and working up to 36 H.P. if necessary. Next there are two dynamos by Messrs. Mather and Platt, of Manchester. The seven arc lamps are equal to about 3,000 candles each, and the incandescent lamps are of 20 C.P., working with an E.M.F.of 90 volts. The safety of the structure from fire is ensured by the application of one of the Woodhouse and Rawson automatic magnetic "cut-outs." The incandescent circuits are two—one lighting the south, the other the north of the building—and either of these can be turned off in the engine-room at will. The governor in use is a Porte-Manville electric governor. The electromotive force of the incandescent circuits is continually tested by a Cunynghame (Woodhouse and Rawson) voltmeter, an ammeter (Cunynghame) giving the exact current flowing through the arc light circuit. The arc lights are run with a current of 14 ampères.

Among their exhibits the Woodhouse & Rawson Company show a small case for medical and experimental purposes, containing four small secondary batteries which can be charged from the dynamo while the main lights are running—the case being fitted with a laryngoscope whose lamp gives a light of about three-quarters of a candle-power; some of the Trotter distributors, and a number of flowers and breast-pins fitted with electric lights. They also exhibit a switch-board, about 4 feet square, for use on an installation in which accumulators are employed—the light being regulated from the accumulator by a switch in the centre of the board, to bring the lights up or down to the candle-power desired; and some other switches for diverting the dynamo current, and on each circuit there is an automatic cut-out, as already indicated, to secure the safety of the building. The same company shows a variety of portable lamps with reflectors for surgical and dental purposes, fitted in handy cases; Mackenzie's "sounder indicator," by which the person using an electric bell can tell whether or not it has sounded at the other end; and it likewise shows the Jensen system of electric bells.

The only other electric light exhibit is that of the Æolus Waterspray Company, whose patent professes to enable householders and others to dispense with engines and dynamos and yet have the advantage of the electric light by means of primary batteries. The Æolus Company also exhibits a number of mechanical telephones. The Electric Portable Battery and Gas Igniting Company has several specimens of its medical batteries fitted each with a No. 2 bichromate cell; medical batteries fitted with two chloride of silver cells; a third make fitted with four Leclanché cells; and portable combination bells, fitted with Leclanché cells. The Stanhope Company exhibits long distance telephones and Byng short distance acoustic telephones; and lastly we come to James Fraser's (Leeds) Atlas telephone, which is at the service of any one in the building. Through one of these instruments in Leeds, measuring three and a half miles, it is stated that the ticking of a watch can be heard. It is perhaps worth noting that this telephone has lately been fitted up on one of the White Star Atlantic steamers.

The exhibition includes almost everything that can be connected with the erection, lighting, ventilating or furnishing of a house, clothing, food, and numerous other things more or less aids to sanitation. Large numbers of people have been attracted by the electric light, the exhibits and the music; indeed, the Sanitary Congress at York was more successful in every way than any of its eight predecessors.

REVIEW.

Short Lectures to Electrical Artisans; being a Course of Experimental Lectures delivered to a Practical Audience. By J. A. FLEMING, M.A., D.Sc. (Lond.). London, E. & F. N. Spon, 125, Strand.

The series of nine lectures, of which this work is a reprint, were delivered at the request of Mr. R. E. Crompton before the pupils and workmen associated with the well-known firm of which the latter gentleman was the founder. Mr. Crompton is to be much commended for the spirit which he has displayed in arranging for the course of lectures, and for his selection of Dr. Fleming to deliver the same.

In the first lecture the elementary laws of magnetism are dealt with, and although the matter with reference to the magnetic units is, we should be inclined to say, rather above the comprehension of the average electrical artizan, yet the subject is dealt with in a clear manner. The important practical points as regards the physical qualities of iron are carefully explained. In Lecture II. Oersted's discoveries are considered, and the practical results of the discoveries explained; in the same chapter Faraday's laws of induction of currents are enlarged upon; the effects of electric inertia being pointed out. In Lecture III. we notice a practical simile of residual and permanent magnetism, the former being compared to the slight permanent twist which remains in a brass wire when the latter is twisted beyond a certain point; permanent magnetism is likened to the permanent twist which takes place in a lead wire, the metal having practically no resiliency. We next have (in Lecture IV.) "Form of Electro-Magnets," "Long Pull and Weight Carrying Magnets," "Field-Magnets," "Foucault or Eddy Currents," "Induction Coils," "Secondary Generators" explained. The succeeding lecture deals entirely with the electrical and other units. Several instruments for the measurement of current are explained and illustrated, though no opinion is expressed as to their relative merits. As a matter of fact, we are still in the position of not possessing a satisfactory form of ammeter, in spite of the immense amount of labour and skill which has been devoted to the subject. With reference to voltmeters, the only really satisfactory instrument as regards accuracy is the "Potentiometer," originally devised by Mr. Latimer Clark; the apparatus, however, is not a very portable one. A convenient form of this instrument is described by Dr. Fleming in Lecture VII. In a foot-note in this chapter exception is taken to the word "resistance," on the ground that it is understood to express "a kind of *active* opposition." This we very much doubt to be the case; the general impression is, we are almost sure, that resistance is a *passive*, not an active opposition. Dr. Fleming considers that we must regard resistance merely as a ratio; if this is the case, it seems that we should do the same of every derived unit. Towards the end of the work batteries, both primary and secondary, are described; we then have "Electro-

Motors," "Measurement of Work," "Efficiency of Motors," "Reaction between Armature and Field Magnets," "Counter Electromotive Force," "Measurement of Efficiency of Motors," and the apparatus for the determination of the same, gone into. A short Appendix is added. Altogether, we consider that the course of lectures may be profitably read by those who wish to obtain an intelligent appreciation of the work of which Dr. Fleming treats.

ROYAL JUBILEE EXHIBITION, MANCHESTER, 1887.

IN order to fittingly commemorate the jubilee year of Her Majesty's reign, it has been decided to hold an exhibition under the above title, in the city of Manchester, from May to October, 1887. The object of the exhibition will be to illustrate, as fully as possible, the progress made in the development of arts and manufactures during the Victorian era, principally under the following sectional headings :—

1. Industrial design, as shown in textile fabrics, pottery, glass, metal, wood, marble, and stone work, and all useful articles having a decorative or ornamental design.
2. Machinery in motion and general engineering plant and appliances.
3. Chemical and allied industries.
4. Handicraft work in process of production.
5. Works Committee ; and representation of Old Manchester and Salford ; model of the ship canal, &c.
6. Fine arts—limited to works of art produced in the United Kingdom during the reign of Her Majesty the Queen.
7. Electric light, music, horticulture, &c.

The site chosen is at Old Trafford, adjoining the botanical gardens, which it is proposed to incorporate with the exhibition. It will cover a space of about 32 acres, which, in case of need, may be extended, and is of easy access from the city by road and rail.

The plans of the building, which have been approved by the executive committee, are exceedingly simple and compact. The main building consists of a central nave 1,022 feet long and 56 feet high, with a transept across the centre 370 feet long and the same height, and two lower transepts near the ends of the nave 60 feet wide. At the intersection of the nave with the central transepts is a dome 90 feet diameter and 140 feet high, and at the intersection of the nave with the low transepts are square pavilions of a lower altitude. The spaces between the nave and the arms of the cross are filled with exhibition courts, in bays 30 feet wide.

The machinery in motion will be provided for in a large annexe, separated from the main building by a 70 foot roadway, with a covered fireproof gallery of communication.

Special care has been taken in the construction of the section intended to be devoted to fine arts. It is completely isolated from the main building by stout brick walls, with iron sliding fire proof doors ; the brick walls will be covered inside with Parian cement, which secures absolute immunity from damp. The most complete arrangements will be made for watching, night and day ; and the lighting will be so arranged that under no possible circumstances can any injury arise to the works exhibited. The committee, therefore, confidently appeal to the owners of treasures of art produced during the reign of Her Majesty the Queen, trusting that they will generously respond to the desire that this exhibition shall be in every way a worthy successor to the Great Art Treasures Exhibition held at Manchester in 1857.

The Guarantee Fund exceeds £132,000, and the guarantors are represented by a council elected from their body, presided over by Mr. Alderman Philip Goldschmidt (Mayor of Manchester), and which council represents the ultimate Court of Appeal on all matters connected with the exhibition.

The entire control of the whole arrangements is in the executive committee, appointed by the council of guarantors, consisting of 30 members, with Sir Joseph C. Lee as chairman.

The Lancashire and Yorkshire Bank, Limited, have undertaken to open a branch in the exhibition building, for the convenience of exhibitors and others, where all ordinary banking business will be transacted.

NOTES.

Proposed Electric Lighting at Liskeard. — The matter of the lighting of Liskeard by means of electricity has been taken up by a number of the inhabitants, the Town Council having declined to take any action in their official capacity. Communication was made with Messrs. Laing, Wharton and Down, as a result of which, a gentleman representing that firm has visited the town and expressed an opinion that electricity might be successfully employed, especially considering the special advantages which were enjoyed in connection with the water-power. At a meeting held a few days since under the presidency of Mr. W. Nettle, the Mayor, and attended by the principal inhabitants, it was decided to experimentally light the town by means of electricity. A committee was appointed to carry out the necessary arrangements. Subscriptions amounting to £36 were announced at once.

Sale of Electric Light Plant.—Last week Messrs. Edward Smith and Boggis, and Messrs. Sexton and Grimwade sold by auction at the Electric Light Works, Culver Street, Colchester, the entire plant, machinery and stock belonging to the Electric Lighting Company. There was a fair attendance and good competition. Among the principal items was a 25 horse-power semi-portable engine and boiler, by Davey, Paxman & Co., which was bought for £200 by Mr. Henry Jones, who was also the purchaser of 62 feet of 12-inch double main driving belting at £12 and another lot of belting at £7 19s. 6d. A 1,000 volt Parker-Elwell dynamo fetched £52 10s., to Mr. Price, of London ; a Victoria dynamo (about 150 volts) fetched £22, to Mr. Jeffery, London ; and a No. 5 Brush dynamo for six arc lights, £22, to Mr. South, of London. Two tons of old lead in two deal cases made £16 10s. to Mr. Hyman, London ; and about six cwts. of No. 8 gauge copper wire, £12, to Mr. Wright. The *Colchester Gazette*, commenting upon this sale, says :—" The electric light in Colchester is now a thing hopelessly of the past, the very lamps and wires having been sold under the hammer. The history of these unhappy lamps and wires, together with all the paraphernalia of dynamos, accumulators, carboys, armatures, motors, and all the rest of it has been a melancholy one. It has been a case of foisting on a good, steady-going, old English town a scheme which could only have been made to answer in some roaring young city in the United States."

Electrical Illumination of Lighthouses.—On and after the 15th October an experiment of an important nature is to be made upon the bar lightship at Liverpool, the Mersey Docks and Harbour Board having decided to exhibit tentatively an electric light instead of the present oil light. The new light is to be visible at a distance of 10 miles, and will show a flash every half minute from sunset to sunrise.

Hotel Lighting by Electricity. — The Birkdale Palace Hotel at Southport has just been lighted by electricity. There are 200 incandescent lamps of 20 candle-power each employed, and five arc lamps of 1,600 candle-power each, which are placed in the ball room and grounds. The work has been done by the Maxim-Weston Electric Company.

The Electric Light at the British Museum.—A correspondent writes to the *Globe* :—"What is the matter with the electric light at the British Museum ? It was not available, it seems, on Saturday evening, and now we are told it will be several days before it can be used again. It is to be hoped the subject will be thoroughly gone into, with a view to the regular supply of good—*i.e.*, a clear and even—light. There are some, probably many, *habitués* of the reading-room who would rather be without the light than have one which bobs and blinks until it becomes at times absolutely distressing."

Electric Lighting at Stockport.—During recent festivities at Stockport a great portion of the town was brilliantly illuminated by means of arc lamps of the Jablochkoff type. The current was supplied by an alternating current Gramme dynamo. The lighting was carried out by Mr. George Durham, of Stockport, who has been complimented by the Town Council for the manner in which his contract was performed. The Red Bull Hotel was at the same time lighted by incandescent lamps, and pretty effects were produced by the illumination of the ferneries and fountains at the back of the hotel.

A Novel Idea of Electric Lighting.—At a new hotel in one of the largest towns of the Midlands, it was announced by the proprietor as one of the attractions of his house, that on and from a certain day the building would be lighted by electricity ; accordingly an admiring crowd assembled on the day in question to witness the inauguaration of the new installation. The delight of the expectant ones may be imagined when the operation of lighting the *gas* in the hotel by one of the electric gas lighters was duly gone through. The proprietor had, we believe, some reason to regret his announcement on the withdrawal of many of his customers.

Lighting Steamers by Electricity.—A set of large engines and dynamos have recently been fitted on board the ss. *Orifaba*, of the Orient Line. The vessel left the dock on Wednesday, and started from Gravesend on her first voyage on Thursday. The set consists of two tandem compound engines, placed side by side, and of two direct-driven "Kapp" slow-speed dynamos placed in line, one on each side. The engine shafts can be coupled together or uncoupled, a lever being provided for working the coupling ; each engine can drive its dynamo independently, or both engines can drive both dynamos together. During the daytime one dynamo only is to be used, and at night both will work together. The arrangement of placing the dynamos outside and the engines inside with means of coupling up if desired, has been adopted on the recommendation of Mr. Brice Douglas, M.I.C.E., the consulting engineer to the company. Each dynamo gives an output of 240 ampères at 55 volts when running at 245 revolutions per minute. Since the vessel has to pass through tropical climates, the temperature in the engine room, where the dynamos are placed, will be very high and the cooling effect of the surrounding air very small. To overcome this difficulty two fans have been provided which draw fresh air from the deck and discharge it against the armatures The density of current in the armature and other conductors has also been chosen very low, being under 2,000 ampères per square inch in the armature and considerably less in the magnet coils. The set of engines and dynamos has been manufactured by Messrs. W. H. Allen & Co., of York Street Works, Lambeth, who have also supplied a second set to a sister vessel which is now being fitted. The whole of the wiring and fitting, comprising over 500 lamps, has been done by Mr. Gray, the company's electrician, under supervision of their inspecting engineer.

Electric Lighting in Taunton.—The *Gas World* seems to find it very difficult to reconcile itself to the advance which electric lighting is making in public favour, and this is the way in which it speaks of a contemplated installation at Taunton :—"It has been said that 'extremes meet,' but in the matter of public lighting it has been left to the Town Council of Taunton to establish the accuracy of the proverb. This week it has adopted a resolution, by a majority of ten to seven, to light the main thoroughfares with arc lamps, and the alleys and courts by means of oil. Hitherto we have been inclined to regard the competition for public favour in the matter of illuminants as a triangular combat, in which the advocates of each particular system fought for their own hand ; but now we see the 'unsteady' and the 'troublesome' lights joining issue against gas. It is a peculiar combination, and it will be interesting to watch how long it continues. We are inclined to think that the majority of the members of the Taunton Town Council, in coming to the conclusion to use electricity and oil, were not influenced altogether by purely public or economical considerations ; although we must admit that nothing has as yet appeared in print to indicate that there has been a rupture with the Gas Company. The Watch and Lighting Committee appears to have gone minutely into the subject of cost, and its report which we give in full on another page, shows that gas is cheaper than electricity, and we know that, as a light to be depended on, no comparison can be made with gas and any of the other two illuminants. Even if the best machinery that is made for electric lighting purposes were introduced at Taunton, the electric light will flicker, splutter, and sometimes be totally eclipsed ; and with oil, the flame as a rule is so soft that, during the prevalence of high winds, its luminosity is sadly impaired. As, however, the residents in alleys and back courts usually compose the poorer portion of the community, it may have been thought that any sort of light is good enough for them."

The Colchester Electric Lighting Installation.—The last act in the drama of electric lighting which has had such a miserable career in Colchester, says the *Gas World*, was performed on Wednesday, in the presence of a motley assemblage of those "peculiar people" who speculate in old iron, and who hover in the vicinity of establishments that have come to grief, in the hope of picking up bargains. The "installation," from which such great things were expected, has been brought to the hammer, and the munificent sum of £345 has been realised. When we cast a retrospective glance over the history of the company which undertook the reform of artificial lighting in Colchester, we are led to reflect upon the mutability of human invention. At the outset of the career of the company we were entertained to instances of merchants discarding foul gas for the kindly glow lamp, and theses were written by enthusiastic admirers of the new system of lighting, describing the manifold sanitary advantages which inevitably follow the introduction of electricity. But while these matters were being publicly discussed, the capital of the company was being slowly, though surely, absorbed. Shareholders familiar with the serious losses sustained in other parts of the kingdom refused to supply more funds, and, as customers were limited in number, the company had no alternative but to cease operations. An endeavour was made to raise a Phœnix from the ashes of the defunct company, but the effort proved futile ; and now engine, dynamos, wires, and lead have been sold for £345.

A Fire Caused by the Electric Light.—At the Berlin Art Exhibition a fire broke out in the Pergamon panorama, caused, it is said, by the electric light. One of the audience was cool enough, while the heat was becoming intense, and the glass roof was falling in fragments round his head, to remain and persistently demand the return of his entry money.

Lundy Island Telegraph.—The Lundy cable, which has been out of order for some weeks past, was repaired on Saturday, and telegraphic communication with the signal station re-established.

Cable between Halifax and Bermuda.—Admiral Commerell, writing in the *Morning Post*, in answer to a previous letter on this subject, says :—"Sir E. Watkin has advocated very strongly the advisability of laying a cable between Halifax and Bermuda, a course of action of which I entirely approve, as it seems to me a great defect that our principal naval station in North America should be unconnected with England by cable. Sir E. Watkin, however, exaggerates the size of the dockyard and its capabilities. The small basin will only hold six vessels at most, and the facilities for coaling are very defective. The strength of the garrison also and the defences are quite inadequate. He is also in error with regard to the floating dock, which will not take our largest ships, simply because the bar of Bermuda will not allow them to get to it."

"A Naval Officer," writing upon the same subject, says :—"From a maritime and Imperial point of view would it not be better to complete the circle by a cable from Bermuda to England? By joining up the Azores we should have the great benefit of obtaining a meteorological station, which would render us nearly independent of the weather reports issued by our American friends, deduced from their chain of stations stretching across the great American continent, and we should be able to foretell with almost absolute accuracy the date of arrival of the cyclonic disturbances on our coasts. In the case of a rupture, unlikely though it be, with America our naval authorities would be in communication with the naval port of Bermuda, even if all the telegraphic communication between the two Continents were interrupted, and that part of the line between the Azores and England would be very useful from both a mercantile and maritime point of view."

West African Cables.—The Silvertown Company has received a telegram from Mr. Matthew Hamilton Gray, the engineer in charge of the West African expedition, announcing the completion of the system of submarine cables which the Silvertown Company has been manufacturing and laying under contract with the West African Telegraph Company. The total length of cable amounts to about 3,600 nautical miles, laid in ten sections, and giving telegraphic communication with Europe to Dakar (Senegal) to Bissao and Bolama (Portuguese Gambia) to Bathurst (Gambia), to the French possession of Conakry, and to Sierra Leone; there are also connections to Accra, Grand Bassam, and to Porto Novo or Kotoonou, all on the Gold Coast, and the cables then continue to the Portuguese Islands of Sao Thomé and Principe, to the French possession of Gaboon, and to the Portuguese territory at Loanda. In addition to these sections laid for the West African Telegraph Company, the Silvertown Company has laid two sections for another company, connecting St. Vincent with St. Thiago (Cape Verde Islands), and this latter island with Bathurst, on the West African Coast. The total shipping which sailed from London in connection with this cable-laying expedition amounted to 14,600 tons, in six bottoms. The Telegraph Construction and Maintenance Company, of Greenwich, has also laid on the West African Coast over 2,000 nautical miles of cable, placing, besides the stations above-mentioned, Lagos, Brass, and Bonny in telegraphic communication with Europe, and giving a duplicate communication to Bathurst and Sierra Leone. Considering the climate, the heaviness of the surf which generally breaks on the West African coast, and the magnitude of the work the staff of the Silvertown Company, and the staff of the Telegraph Construction and Maintenance Company, are to be congratulated on the complete success which has attended their efforts.

Colonial and Indian Exhibition.—H.R.H. the Prince of Wales has decided that the present exhibition shall close on the evening of Wednesday, November 10th.

Electric Motors.—According to the *Electrical World*, statistics show that about 5,000 electric motors are employed in the States.

West London College of Electrical Engineering.—At a final examination, held before Mr. H. Hartnell, Technical Officer of the G.P.O., and the Principal, Mr. W. Lynd, a few days ago, the following gentlemen obtained their certificates :—Mr. A. W. Jones, of Birkenhead, 95 per cent. of marks; Mr. T. Pardoe, of Littlehampton, 90 per cent.; Mr. Hugh Davidson, of Haselor, Warwickshire, 80 per cent. Mr. Hartnell expressed great satisfaction at the result of the examination.

The Gelatine Battery.—Much is made in Cincinnati of a gelatine battery, made and controlled by the Cincinnati Electrical Company. This battery was invented and first used about a year ago. In its primitive form it was somewhat crude. The *Electrical World* (New York) explains that Mr. H. B. Cox, the electrician of the company, noticed one thing, and that was its slowness to polarise. He also observed that its resistance was somewhat reduced, instead of increased, as he had expected or feared it would be. He started to experiment with the same, and made, during his laboratory experiments, some 400 batteries. His desire was to make a battery that would have the following points :—Slowness to polarise; strength, about 1½ volts; low resistance; no evaporation and no salts; and should be one which no amount of heat or cold could affect, and one which could be set up complete and shipped in that condition. In the "gelatine" battery he believes they have all of these points. Should the jar become accidentally broken, it does not in the slightest affect the working of the cell. Mr. Cox claims to be the first inventor of this style of battery, and thinks his claim a just one, for the reason that he has had a "gelatine" battery in use for the past eight months or more, and has been for that length of time working constantly to perfect and market it. "On ordinary open-circuit work," says Mr. Cox, "I judge the battery will last about ten years without any attention whatever. It has a carbon electrode with 48 square inches of surface and a drawn zinc electrode half-an-inch square, and the gelatine excitant can only be dried at an intense heat and that after repeated baking.

The Institute of Civil Engineers and Electricity.—The following are among the subjects upon which the Institute of Civil Engineers invite original communications, for which premiums will be awarded :—Electro-motors: their theory, practical construction, efficiency, and power. The construction and maintenance of secondary batteries. The distribution of electric currents for the electric lighting of towns. Thermo-electric batteries, and their application to electro-plating and other purposes. The application of dynamo-electric machines to the electro-deposition of metals from their ores. In writing these essays the use of the first person should be avoided. They should be legibly transcribed on foolscap paper, on one side only, leaving a margin on the left side, in order that the sheets may be bound. Every paper must be prefaced by an abstract of its contents not exceeding 1,500 words in length. Illustrations, when necessary, should be drawn on tracing-paper, to as small a scale as is consistent with distinctness, and ready to be engraved. When an illustrated communication is accepted for reading, a series of diagrams will be required sufficiently large and boldly coloured to be clearly visible at a distance of 60 feet. These diagrams will be returned.

The Exchange Telegraph Company and the Stock Exchange.—It is reported that the Exchange Telegraph Company has at length come triumphantly out of its tussle with the governing body of the Stock Exchange, and has gained a firmer footing in the "House" than ever. The company, it will be remembered, says a daily paper, was summarily ejected some time ago because the members of the Stock Exchange found that their business was leaking away to the "bucket shops" through the wires of the Exchange Telegraph

Company. Then business was dull; now it is tolerably active. In the latter circumstances both jobbers and brokers are able to estimate the value of the "tape" more accurately, which is tantamount to saying that they have all along known that it had become, both to themselves and the public, indispensable, although in the heat of disappointment and chagrin at seeing too much of the little business there was done by outsiders they foolishly determined to make the Exchange Telegraph Company a scapegoat.

Electrical Communication in the Navy.—A committee has been ordered to assemble at Portsmouth to consider the whole subject of voice, mechanical and electrical communication between the deck and engine-room of men-of-war, with special reference to the great sub-division of a modern ironclad. The committee will consist of the Captain of the Steam Reserve, the Captain of the *Vernon*, the Chief Inspector of Machinery, Mr. Richard Sennett of the Admiralty, and the Chief Constructor and the Chief Engineer of the Dockyard.

The Reckenzaun Tramcar System.—*Invention* says: "We have of late received several enquiries as to the merits of Reckenzaun's system of electric tramcars, and it appears to us that this excellent system is at last obtaining well-deserved general recognition. It is hardly necessary to remind our readers that it is in successful use on the lines of the Berlin tramways (the Grosse Berliner Pferdebahn Gesellschaft), and we must express our surprise that it has not made greater progress in this country after the very satisfactory trials on the lines of the South London Tramways in April last year. The necessity of a special Act of Parliament doubtless operates unfavourably in this country, and is the only excuse for the non-adoption of the system on British tramway lines."

Town Lighting.—The West Houghton (near Bolton) Local Board, having failed to come to terms with a private company as to the purchase of the gasworks, is now threatening to light the whole township, which has 10,000 inhabitants, with paraffin lamps. One portion of the town has already been lighted in this manner, and the Bolton Rural Sanitary Authority, which covers 26 townships, on Wednesday decided to try the experiment of lighting portions of their district with similar lamps. Some of our enterprising electrical firms should place themselves in communication with the Bolton folk.

A Large Incandescent Lamp.—One of the most decided novelties brought to the attention of the electric light convention at Detroit was a 400 candle-power incandescent lamp requiring only 425 watts. At least, these were the figures given in all seriousness; and the lamp is said to have been remarkably brilliant and effective. There is undoubtedly a field for large incandescent lamps, remarks the *Electrical World*, as one of the speakers said at the convention—just where the arc light stops short, and above the range of ability of the small incandescent lamp; and we are ourselves very glad to see work being done in this direction. It will, of course, be understood that the figure of only little more than one watt per candle-power does not apply to small lamps. The inventor claims it only for his large lamps, and we think he or any others working that way deserve very careful attention and considerate hearing. There is a good field and future for large and economical incandescent lamps, run, too, for long-distance lighting, off arc circuits.

Patent Office Report.—The report of the Comptroller-General of Patents, Designs and Trade Marks, for the year 1885, has just been issued. The number of applications for patents during the year was 16,101, a falling off of 1,009 only from the number (17,110) applied for in 1884, the first year of the new Patent Act. Of this total, 11,695 were made through agents (about 73 per cent.), the remainder, or 27 per cent., being made directly to the Patent Office by the applicants themselves; 77 per cent. of the total applications were made from persons resident in the United Kingdom; 112 applications for amendment of specifications before the sealing of the patent, and 61 applications for amendment after sealing, were made at the Patent Office. Of these 173 applications, 120 were allowed by the Comptroller, 13 were refused, 4 were withdrawn or abandoned, and 36 were not dealt with during the year. During the year, 4,383 notices of similarity of inventions applied for were given in respect of 2,531 applications, and 49 applications previously included in prior applications were reported. About 120 under Section 94 (which provides that a personal hearing shall be given to the applicant before refusal) were heard by the comptroller. Only a single application, and that an informal one, was made for a compulsory licence. The number of readers who frequented the library during the year 1885 was 44,176, against 39,508 in the previous year. The total receipts of the office amounted to £88,509, the payments being £77,740, leaving £10,769 surplus income.

Gas, Electricity, and Oil.—The people of Taunton have been calculating the relative properties of gas, electricity, and oil for the purposes of public lighting. There are some ratepayers who are advocating a return to "the dark ages," and the substitution of oil for gas, whilst others are in favour of as great an advance and the adoption of the electric light. The proposal is to light the centre of the town by electricity, and the outer districts by oil lamps. The Watch, Lighting, and General Purposes Committee have presented a report to the Town Council, in which they give a comparative statement of the cost of lighting by the three processes, but the estimate is founded upon the assumption that the town shall be lighted only for an average of six hours per night instead of eight as at present. The following are the details of the estimates:—

By Oil and Electricity.

Cost of oil at 7d. per gallon for the outer district	£300	7	8		
Four men	156	0	0		
1-7th of cost of wicks, fittings, and repairs	30	0	0		
				£486	7	8
The cost of 29 electric lamps for the central district would be, at £20 each	£580	0	0		
1-7th cost of posts	18	0	0		
				598	0	0
Making together				£1,084	7	8

By Gas.

The cost of lighting the whole town for the year, ending 15th June, 1886, was	£882	6	6		
Hewlett's bill calculated upon average of 1884 and 1885	55	9	2		
				£937	15	8

By Oil.

The cost of lighting the whole town would be as follows:—

Cost of oil for 350 lamps at 7d. per gallon	£399	4	4		
Five men	195	0	0		
Wicks, fittings, repairs, &c.	50	0	0		
				£644	4	4

A special meeting of the Town Council was held last week to consider the report. Councillor Standfast presented two memorials from ratepayers, one of which represented that the proposed scheme of lighting was very unjust, and likely to cause a heavy increase in the rates, which was protested against, and suggested that a public meeting should be called. The other memorial asked the council not to adopt any system of lighting which would increase the rates. Councillor Sibly moved the adoption of the report of the Lighting Committee, and said in the deliberations of that committee not one word had been said hostile to the Gas Company,

their simple desire being to improve the lighting of the town. They knew that the electric light would not be suitable for the numerous courts and alleys in the town, but for the broad open streets he knew of no town so well adapted for the electric light as Taunton. After some discussion the proposition for the adoption of the recommendation of the committee for lighting the central district of the borough with electricity and the remainder with oil was carried by 10 votes to 7.

Telephone Litigation.—We hear that the telephone war is about to break out again in an old quarter. Writs have been issued by the New Telephone Company against the Western Counties and South Wales Telephone Company and against Mr. Lewis, its manager, and the district superintendent at Bournemouth, Mr. O'Donnell, for alleged slander of title. The United Telephone Company, which for some time maintained that there was infringement of its patents by the New Telephone Company, long ago stated that it was about to bring an action for infringement against that company on this ground; but when challenged in Mr. Justice Chitty's court to substantiate its threats it declined to do so. The New Telephone Company, however, allege that the licensees of the United Company have, nevertheless, continued to circulate false statements to the damage of the New Telephone Company's business, and the latter has opened fire by serving writs upon the Western Counties Company. As the accusations of infringement have been made openly and wholesale, heavy damages are talked of; and the impending action is already attracting the notice of the electrical world as one of more than usual interest.

Signalling by Gas.—A gas semaphore, designed for night signalling purposes, was tried for the first time on Friday last, and did not by any means prove an unqualified success, owing, it is explained, to a collapse in the supply of gas. The utility of the electric light for signalling purposes of every description is so obvious, that it can only be a matter of surprise that any attempt should be made to adapt gas to a purpose for which, as compared with its powerful rival, it is obviously ill-suited. The semaphore has been erected at Mount Wise, Plymouth, and it consists of arms six feet long which branch out in various directions, so as to represent the various letters of the alphabet, and have at their extremities three gas-jets. The latter are enclosed in brass cups, which prevent the light from flaming out until a valve is pressed. Under ordinary circumstances, the valves would be played upon like the keys of a piano. For the purposes of the trial the *Harpy*, tender to the *Royal Adelaide*, steamed out towards the end of the breakwater, about two miles from the Mount Wise lighthouse. The weather was considered to be favourable to a satisfactory trial, but the fates were unkind in other directions, and owing, it is said, to the thickness of the weather, great difficulty was experienced on board the tender in deciphering the signals which were made from the lighthouse. After some trouble, however, and with the kindly aid of a night glass, a signalman on board managed to make out, with what is described as "tolerable distinctness," the signals "God Save the Queen," and "Success to the Gas Semaphore first tried in this her Jubilee." Little else was attempted, and the effect of the evening's experience is said to have rather damped the ardour of those devising the enterprise. However, they had sufficient faith to consider that the result fully demonstrated the possibility of using gas in the manner indicated. We are told that many alterations were suggested, and we also hear that there is plenty of room for improvement.

The French Cable Company.—*Le Matin* says:—"It is known that the directors of the French Cable Company have called a general meeting for October 6th next, but it will be remarked that the notice convening this meeting was not published a day or an hour before the date fixed by the Tribunal of Commerce. It is to be supposed that these gentlemen, fearing, not without reason, a fresh vote of distrust, were not in a hurry to meet their shareholders, or that they wished to give the English as much time as possible to buy up the shares. Whatever may be the cause which lead the board of directors to temporise in this affair, it is fortunate the tribunal had given judgment, or perhaps the shareholders would not have been called together till next year. It is by acts of this sort, much more than by their circular, that one must judge the directors who still preside—but probably not for long—over the destinies of the company. Moreover, one has only to examine the unfortunate position of the undertaking to wish that the management should be transferred to the hands of more experienced men, who will pay more attention to the well-understood interests of the shareholders. Indeed, beyond the fees, and perhaps a few small profits, one would like to know what interest Messrs. Riant and Pouyer-Quertier can have in the prosperity of the company. The number of shares possessed by these gentlemen is very insignificant, and contracts like those granted to the English (Harding's commission, £50,000) are not signed every day. In this respect, it is quite immaterial to them whether the company prosper or fail; until the day when the English, so ready at such work, shall absorb it altogether. It is true that at the next meeting the directors will figure as holders of a large number of shares—by what miracle? whilst at the meeting of June 23rd last M. Pouyer-Quertier only held 160 shares. Is it after having signed the English agreements, that Messrs. Pouyer-Quertier and Riant intend to prevent the French company from falling into foreign hands? When we see these gentlemen playing on a fantastic theme, the grand patriotic air—they, the signers of the English agreements—we are tempted to ask ourselves whether we are not the sport of a dream."

Too Much Light at Hell Gate.—A despatch from Washington says:—"When Congress made the appropriation for the electric light at Hell Gate, it was supposed that the problem of lighting that dangerous passage and inland waters had been solved. But the deliberations of the Lighthouse Board here yesterday seem to throw great doubt upon the adaptability of electricity to this purpose. The quarterly session of the Lighthouse Board, just closed, was largely occupied in discussing the question of electric lights as applied to the lighthouse service. Protests of the most emphatic character were received from the maritime interests of New York against the maintenance of the electric light at Hallett's Point, which is the only one in the service. Captains and pilots state that it blinds them and renders them unable to measure distances—so much so, that tugs with heavy tows refused to pass it at night. The board seems to be in favour of discontinuing the light."

No More Bridge Jumping.—The Brooklyn Bridge police are no longer in fear of madmen wanting to jump into the river. The life lines on the big cables have been connected with one of the electric light circuits, and, as a member of the force put it, the first man, woman, or child who touches them will have to be taken to the hospital.

The Marchant Engine.—The following communication from Mr. Radcliffe Ward came to hand too late for our correspondence columns:—"The principle on which this engine is based to obtain unusual economy of fuel is perfectly clear. A certain number of heat units are contained in that which passes away from an ordinary engine; if the additional heat units (or in other words power) that are required to force back into the boiler that which ordinarily passes away are con-

siderably less than that which they have to force back, then there is obvious economy in the Marchant system. To effect this has evidently required no small amount of inventive genius and engineering skill. I have had the pleasure of seeing the engine at work, and both from Mr. Marchant and Mr. Downie received every explanation asked for. A brief examination of this engine, coupled with general information as to its cost, leads me to the opinion that so far as steam motors go for electric light this engine marks a most important epoch. The principle, as I have stated it above, is on clear grounds, the mechanism to effect this has been brought into practical existence. I see no reason to doubt the results you obtained, on the contrary, one would expect them. The consumption of fuel claimed will make all the difference on a moderate-sized electric light station of paying a dividend against no dividend at all. This means a good deal to electric interests. There is one point of importance that I am not yet quite clear on, that is, the amount of condensation water required, which for town stations is a vital one."

Train Signalling by Electricity. — Writing to the *Morning Post*, Mr. Charles Pridham, Vice-Chairman of the Electric Signal Company, says :—"Nearly two years since you kindly gave insertion to a letter of mine respecting train signalling by electricity, in lieu of fog signals and steam whistles. The letters that are now appearing in the *Standard* respecting the latter nuisance prompt me to beg space for the following statement. Since I last wrote you, we have been awarded the gold medal of the French Exhibition du Travail, as well as the only medal awarded for train signalling at the Inventories, and have so much simplified the arrangements for train communication, that by merely making and breaking an electric circuit, signals to proceed or stop are exhibited to the engine driver by a semaphore on his engine, and conversely the driver can ask, 'Line clear?' of the signalman. I may add that Dr. Hopkinson, Mr. Cooper, engineer to the Belfast Central Railway; and Mr. Woods, engineer to the railway at Tenby, have seen the invention at work, and testified to its value. The former reports of Enright's electric signals :—'I carefully verified the working of every part of the apparatus, both from the point of view of the signalman at the station, and from the point of view of the driver on the locomotive. In my presence every part of the apparatus performed perfectly, the signals on the locomotive were unmistakable, and the contacts were properly recorded on the drum at all speeds up to 50 miles per hour, the maximum it was practicable to obtain.' Notwithstanding testimony of this character, we have as yet failed to get any railway company to give the system a thorough practical test, although we are prepared to allow the use of it, gratuitously, to any railway company giving it a first trial; the terms dictated by engineers have been so onerous that we hesitate to accept them."

Dynamo Electric Machinery. — Professor S. P. Thompson writes to us just as we go to press :—"In reply to the queries addressed to me in a paragraph of your issue of 17th inst., I beg to say : 1. I should not dream of building a machine weighing 50 cwt. upon this plan, which is intended solely for *small* machines. 2. The coil is placed in the one position where it is possible to wind it direct on the field magnets in the lathe. 3. The method of lacing in the small machines hitherto constructed is a complete success."

Dilatory Telegraphing.—Here is a story which the Post Office authorities can scarcely think creditable to themselves. Mr. L. Knight, writing to the *Morning Post*, says :—"On Friday last my brother, who resides at Chadwell, Essex, about eight miles from here, sent me a telegram, which he despatched at 11 a.m. The said message was received at 148, Mile End Road, at 4.58 p.m., just six hours afterwards, and was delivered here a few minutes before 6 p.m. Cheapness in telegrams may be desirable, but when the said cheapness develops a condition of things as depicted above I think the remedy far worse than the disease."

The Electric Light at Bournemouth.—As a result of the experiments in electric lighting carried out at Bournemouth by Mr. Shepherd, as mentioned by us in our issue for September 10th, a large meeting of the inhabitants has been held, at which it was determined to take steps for the formation of an electric lighting company. It was stated that a canvass of the town had borne very satisfactory results, promises to take quite 1,000 lights having been given. A number of those present gave in their names as intending shareholders, three or four signifying their intention to subscribe for 50 shares of £5 each. A meeting of those interested in the formation of the company is to be held shortly.

American Telephone Patents.—The following paragraph is from the pen of the New York *Electrical Engineer's* Chicago correspondent :—"Nearly all the anti-Bell telephone companies throughout the west and south, having had the seal of the courts placed upon their lips, we hear very little now-a-days about a company which is desirous of having a legal knock-down with the Bell Company. All who were really anxious seem to have got all their aprons will conveniently cover, and the race of telephone inventions which do not interfere with the Bell, or do not infringe, or are patterned after the Reis, or the goodness knows what, seems to be rapidly running out. It is astonishing what a dampening effect the decision of the New Orleans Court, when it smashed the pet idea that because the Bell Company was on trial it was necessarily guilty, had on the patriots who desired to sell stock and start exchanges which could not be enjoined until after the long-winded trial should have been finished. It brought the theory out in full blossom, with glowing colours, but it knocked the poetry out of it, and left it standing quite naked to cold blasts, and in the 'keen bright light of publicity.'"

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Hydrogen Amalgam Company, Limited.—The statutory return of this company made up to the 2nd September was filed on the 20th September. The nomimal capital is £200,000 in £1 shares. The whole of the shares have been issued, the full amount having been called on 7 shares, the remaining 199,993 shares being considered fully paid. Registered office, 23, Cross Street, Finsbury.

Electro-Metal Extracting, Refining, and Plating Company, Limited.—The registered office of this company is at 76, Finsbury Pavement.

CITY NOTES, REPORTS, MEETINGS, &c.

Maxim-Weston Electric Company, Limited.

AN extraordinary general meeting of this company was held at the Cannon Street Hotel on Monday, under the presidency of Mr. Hugh Watt, M.P. The object of the meeting was to consider a resolution submitted by the directors :—"That the directors of the company be and are hereby authorised to issue up to 100,000 shares, at not less than par value of 5s. each, on and after the date

of the passing of this resolution, as, when and how they may think fit."

Mr. J. Buchanan Cox, the secretary, having read the notice convening the meeting,

The Chairman said: Gentlemen, the last time I had the pleasure of addressing you was on February 19th of this year, and in the ordinary course of events I would not again have had that pleasure till about that date of next year, but an exceptional course of circumstances call for an exceptional line of procedure, and the exigencies of the company, I may say in a word, have rendered necessary this extraordinary meeting. To explain fully the cause of the meeting, I must advert to the events of three years ago: then the board, which differs from the present board as regards all its members with one exception, myself, were authorised to issue capital up to 500,000 shares, but at a subsequent meeting, convened and held a year afterwards, upon the suggestion of a shareholder, the directors gave a pledge—a moral pledge—that they would not issue beyond 250,000 shares without the consent of the shareholders. Owing to that pledge we meet you to-day. I may explain at once there is nothing of a legal or statutory character about the pledge, but of course the present board would be most reluctant to take any step whatever which might, in the opinion of the shareholders, be calculated to be detrimental to the interests of the company without taking the shareholders into their confidence, and carrying them along with them. The board have, therefore, found it necessary to convene this meeting; but as the present shareholders of the company, who, I am glad to say, number about 2,000, as compared with 900 when the present board took office, a sign which I think is always of a healthy character, may not be conversant with the early history of the company, with your permission I will very shortly and concisely enter into a short retrospect. And first of all, as some of the shareholders of the company still possess a certificate in the name of the Electric Light and Power Generator Company, it may not be inopportune to mention that that was the original designation under which the company was brought out to purchase and work certain patents. They subsequently acquired the Maxim and Weston patents, when it was deemed advisable to change the name of the company, since which it has been designated the Maxim-Weston Electric Company, Limited, and shareholders justified the action of the board in calling for the present amount of capital. I will simply state that when the present board was formed one or two coadjutors thought proper, no doubt from adequate reasons, to resign. Feeling the onus resting upon them as directors, and the duties and responsibilities and attention very great, and not being in a position, I suppose, to give that amount of time which their duties necessitated, they retired from the company. When the present board took office the capital of the company was, if I remember rightly, 172,500 shares of £1 per share. However, the capital existed, I may say, only on paper. The amount paid for patents amounted to about £130,000, and the balance of the money had been expended in experimental work, &c., and with regard to a portion of the payment, I for one must endorse the action taken by the directors in adding to the patent account by a sum amounting to something like £60,000 by the purchase of the Maxim-Weston patents. In fact, had it not been for the purchase of those patents this company would long ago have ceased to exist. Well, the whole capital of the company was simply gone when the present board took office, and they had therefore to face the position and devise, as best they could, how to raise working capital to carry on the concern. Not only was the capital gone, but the late board had entered into ruinous contracts, and had leases on hand at a very high price. As an illustration I may mention that the rents paid for the factories and office were four times the present rent, although at present, as I shall have occasion to show later on, we possess infinitely better premises for manufacturing purposes and better offices. At that time, under the old *regime*, the expenditure of the company, as appeared in the balance-sheet of 1883, was £16,000 to £17,000 per annum, and the revenue, I am sorry to say, when I joined the board—(I do not want to refer to it now, but under what I might almost call a misrepresentation)—was only about a quarter of the expenditure. We had a somewhat arduous undertaking to go through, but that may be passed over with the remark that we have so far succeeded that I think the company to-day is in a better position than it has ever been, which, of course, has necessitated our meeting you. In passing, I may make one observation, and that is this—so little confidence did the then shareholders of the company possess, that with regard to the new issue of 77,500 shares decided upon by the late board, of that amount only some 2,000 shares were subscribed by the then shareholders, although the price of issue was 5s. The total shareholders of the company at that time had so little confidence in the company that they would not subscribe a sum in excess of £500 to meet the exigencies of the case; the result was the present board had to face the situation and find the capital; and the board, with the addition of one gentleman, who has since resigned on account of ill-health, and myself, found the whole capital. The result was, as you are aware, at the end of the year that the surplus, if I remember rightly, was something in excess of £2,000. There is only one other matter I will refer to before coming to this year, and that is with regard to the Lancashire Company. As I was particularly interested in that company, I will cite to you the words of the then chairman, Admiral Sir Edward Inglefield, as follows:—The chairman said, "Mr. Watt had a large connection with Liverpool, and succeeded so far in establishing our systems there that two other companies had to relinquish the field, and Mr. Watt had received nothing for his trouble and labour, while other promotors, as usual, received large sums." I do not wish to vindicate myself in connection with the matter, but I think it right to inform shareholders, as there are a few present who were shareholders then, that we have had a very severe struggle up till, I might almost say, the present time, to keep abreast of the times with regard to our patents, and to be able to do business of a remunerative character. But I will now pass on to this year's operations. As I told the shareholders the last time I addressed them, the factory accommodation, owing to the growth of the business of the company, had proved entirely inadequate for the purpose of manufacturing. We were then looking out for another factory, and, after going to a great deal of trouble, and taking into account the suggestion made by a shareholder at the last meeting as to the advisability of removing the company's factory out of town some 20 or 30 miles, so as to save expense, we fixed on a factory near Dalston—a factory containing a superficial area about four times in excess of the old factory, for which we pay only 25 per cent. more rent. I think I may say that we at the present moment have been fortunate enough to secure a factory which will be, when all the machinery is erected, the finest electrical establishment in the country, for which we pay a nominal rent. Well, gentlemen, it is only some two months that we have obtained possession of that factory, and, being new, we had it fitted up to suit our requirements, and we are now adding to our plant with the view of manufacturing a heavier class of dynamos and other plant; one essential necessity for manufacturing that plant is that Government contracts will only be given out to British companies manufacturing their plant here. One reason was that in the event of repairs it was altogether absurd and inconvenient for them to have to send that plant to America so as to have it renewed and returned to them here. We shall be, in a month or two, in a position to turn out any amount of plant of our own manufacture up to installations of 1,000 lights. With regard to incandescent lamps I may say this: that the old board expended something like £4,000 in the manufacture of incandescent lamps, and when I joined the company the cost of these lamps, according to estimates made out by Sir Herbert Stanford and myself, amounted to 17s. 6d. each; we managed to reduce the cost to something like 3s., but unfortunately these lamps did not prove to possess the vitality and durability of the American lamps. I may say with regard to the purchase of the Maxim-Weston patents that the old company made a very good condition in insisting on all improvements from the date of purchase, 1882, for five years; they were to have the right to all improvements without paying anything additional. There is only one matter that was overlooked, and that was that they did not stipulate for the plant to be purchased at a price of 5 or 10 per cent. over the manufacturing prime cost. In that case the present company would have saved a very long and acrimonious correspondence, and we should have been in a position to receive plant at a nominal price over the cost of manufacture. However, we have now obtained from the American company a concession of something like 30 per cent. upon what they charge on their dynamos and lamps as compared with what was paid by the late management, and I calculate by manufacturing these machines and arc lamps and everything with the exception of incandescent lamps, we shall effect a further saving of 25 to 30 per cent. If so, we shall be in a position to compete with anything in the market. We have experienced considerable difficulty in doing so, and although the business done this year in volume—in weight of plant—has exceeded by nearly 50 per cent. what we did last year, the money value obtained for that has been in excess of last year, but it has not been in excess in the same ratio as before. With regard to competition, we have still been subject to competition of what I may describe as of an unfair character—that is, firms or companies supplying plant at an absolute loss. I can safely say this with regard to some of the larger contracts we have lost; in one instance which is in my mind, having happened within the last two months. The contract was taken at a loss of something like 40 per cent. upon the actual cost at which the company could put down the plant. Of course we have not undertaken any business of that sort. With the exception of three large contracts we have not lost anything where fair competition was allowed. We have only lost something like three contracts. The amount of business done, I think, has been of a very satisfactory character, and of course in these days of depressed trade, when the largest manufacturer is desirous of saving as much as he can, I think you will agree with me as to the desirability of our being in a position to produce our plant at the lowest possible price. Here perhaps I might refer, because it is a matter of some importance to us—not vital importance, but nevertheless of considerable importance—to the action of a neighbouring company with regard to the infringement of patents. Well, gentlemen, I am happy to say that the American company fought the Edison over the Maxim lamp every step, and were successful. That was the lamp sold to the company. Since then a new lamp has come into the market—a lamp which, I venture to assert, having tested all the lamps of different makers as far as I have received them, is the best in the market—namely, the Maxim-Weston Wavy Filament lamp. We obtain 10 lamps to one horse-power, and any gentleman connected with mechanical pursuits can calculate for himself as to the cost of this lamp as compared with gas. Ten lamps, I estimate, would cost something like 1½d. per hour, all plant included, and wear and tear, and so forth. In the matter of our arc lamps we have effected an economy in getting the same dynamo to give an increased number of lamps. With regard to Edison's action, that action was against a company which possessed

no patents so far as I know. And now I must agree, to some extent, with the Edison. They paid a large sum for patents, and have a perfect right to maintain them; but I think I may say, with all deference, as the Edison and the Brush are powerful companies, that it would have been a wise and more judicious course on the part of the Edison Company if, prior to their proceedings, they had formed a combination of those holding patents of incandescent lamps and had united action. In that case, I have no doubt we should have been successful against all comers, and the large sum we have paid for the patents would not have been thrown away. As it is, in view of the competition of persons who have paid nothing whatever, those firms have had a very great advantage. In the matter of gas engines, in the matter of other patented plant, these have always had protection; why should not incandescent lamps? To refer to the connection of Edison, I may say this, I did not go through the voluminous evidence taken in court. Much was irrelevant and unscientific, but as far as the Edison's position with this company is concerned, I have no hesitation in giving publicity to this fact with regard to the patent under which they are proceeding: the Sawyer-Man claimed priority in America and contested every stage in the proceedings in America necessary for securing the patent successfully. I fail to see how the Edison Company could have any action against this company. They sent a letter similar to what was sent to other companies; that letter was answered by me, and having heard that they were also sending similar letters to our customers, I wrote to say that in the event of such a course being persisted in it would necessitate an action for damages on our part against them, and I strongly advised them not to proceed on a line of conduct which, from a legal or other point of view, was not tenable. They did not take any step beyond sending a general letter, which contained no charge in it, to the effect that they would expect a royalty. If it came to a question of fighting, I do not know but that the Maxim-Weston would have the best of it. It will be a very injudicious thing if they dispute a patent which has already been disputed unsuccessfully by the holder of the same patents in America under which they are proceeding. With regard to our installations, one to which I gave considerable prominence 'at the last meeting, was the Post Office; as to the running, it is very satisfactory with the exception of the fact that it is so huddled together that the temperature of the engine-house is so great as to render the running unsatisfactory. As far as the electric plant is concerned, the different officials have intimated that nothing better could be desired. Since then I have secured several orders from different departments of the Government, and I am now in negotiation with the view of selling a considerable amount of plant as soon as we are in a position to turn out the plant in this country. The last and most important installation was at Palace Hotel, Southport. The light there, as was confessed by strangers, was perhaps the best that has ever been carried out in this country, and what is more to the point than mere eulogy is the fact that I am happy to say that since that was fitted up a few weeks ago we have secured five contracts. Well, gentlemen, I do not know that I have much more to say excepting this with regard to the Edison Company's action, that during the months of June and July business was almost at a standstill. I think that is sufficient to entitle me to say that their action, so far as electric lighting was concerned, was even to themselves detrimental. I am at the same time pleased to say that the orders we had on hand were sufficient to keep us going. During the past few months we have been very busy, and if we go on doing as we are at present, this capital will be absolutely required. The directors have no wish to issue one share more than is absolutely necessary. We have always worked on a very small capital; there is no company who have received so little money as we have. We have some good contracts on hand, and there are other contracts we might secure; but we are not in a position to take them without an increase of capital, and that is the reason we come to the shareholders and ask your consent, concurrence, and approval to the issue of further capital. We are pushing the business of the company. I have only just returned from the north, after securing good business, and our representative, who returned on Saturday, goes out again to-morrow. I leave on Thursday on some very important business; but we are not in a position to close a contract of £10,000 in the present financial position of the company. We have a large stock of plant, sufficient to despatch an installation of 1,000 lights in 48 hours. The Chairman then moved the resolution.

Mr. G. C. Sayce suggested that before the new issue was offered to the public the shareholders should have the sole option of taking the shares at par, and that any which remained should then be offered outside at about 5s. 6d.

Mr. Jackson thought it was doubtful if the public held a sufficiently high opinion of their shares to give anything over par value for them; he did not believe either that the shareholders would take them all up. He deprecated the new issue altogether, and counselled the directors to continue working in the best manner they could with the capital already at their command, and advised the shareholders to be content without a dividend for a time until the company was in a thoroughly sound position.

Mr. Braithwaite, after remarking that it was the custom to offer new issues of shares first to existing shareholders, referred to the question of litigation, and said he hoped the board would not enter into any legal contest without first consulting the shareholders. Promotors and patents, he thought, had been the ruin of many electric companies. As far as he could gather £10,000 had already been expended in the Edison and Swan patent case.

The Chairman stated that if the new issue were agreed to, the shares would be offered in the first instance to the shareholders, and if the applications exceeded the number of new shares, they would be allotted *pro rata*. In reply to questions, the Chairman said the available working capital, excluding outstanding debts, but taking the cash and the plant, might be taken at £25,000. The company paid cash, always securing a discount from trade prices; the whole of the debts did not amount to more than £300. Should there be any litigation as to their patents, the American Company, which was very deeply interested, would probably take the matter up; but he did not believe the Edison and Swan Company contemplated interfering with this company.

Further conversation ensued, and an amendment was submitted, that the matter should be left to the next general meeting, this meeting with very slight support a further amendment was moved limiting the issue to 50,000 shares. This secured only seven votes, and eventually the original motion was carried by an overwhelming majority.

A vote of thanks to the chairman brought the meeting to a close.

The Eastern Extension Telegraph Company, Limited.—This company notifies that the accounts for the half year ending June 30th last show, subject to audit, a balance of profit of £66,230, after payment of the interim dividend for the first quarter. The directors have declared a dividend for the quarter ending June 30th of 2s. 6d. per share, free of income tax, pay ble on the 15th prox., and decided to carry forward the balance of £34,980 to the next account. In consequence of the diminution of dividend of revenue the directors do not feel justified in paying any bonus for the past half year.

Reuter's Telegram Company, Limited.—The directors have declared an interim dividend at the rate of 5 per cent. per annum, free of income-tax, for the half-year ending June 30th last, payable on the 9th prox.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending September 24th were £2,817 after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

NEW PATENTS—1886.

12097. "Electrical communication apparatus for use in navigable vessels and other purposes." W. CHADBURN. Dated September 23.

12098. "Electro-magnets." T. H. WILLIAMS. Dated September 23.

12109. "Electrical drop indicator." R. PRICE. Dated September 23.

12114. "Galvanic battery for generating and storing electricity." J. NOAD. Dated September 23.

12117. "Electric furnace." W. MAXWELL. Dated September 23.

12137. "Cutting and removing kite tails, string, &c., from telegraphic and other conductors." J. POOLE, K. MACIVER. Dated September 24.

12165. "Electric generator." W. STANLEY. Dated September 24.

12169. "Dynamo-electric machines." G. C. FRICKER. Dated September 24. (*Complete.*)

12180. "Hand electric lamp." W. E. MOSER. Dated September 24.

12222. "Electric apparatus for indicating time." R. J. RUDD. Dated September 25.

12235. "Primary electric batteries." G. F. ROSE. Dated September 25.

12257. "Electric batteries." G. BINSWANGER, C. POLLAK. Dated September 27.

12264. "Construction of transformer." W. H. SNELL. Dated September 27.

12270. "Wire gauge for use of electricians." L. EPSTEIN. Dated September 27.

12315. "Automatic electric cut-outs." A. BERNSTEIN. Dated September 28.

12317. "Apparatus for receiving and displaying prepaid messages, &c." P. EVERITT. Dated September 28.

12357. "Applying improved electric mercury contacts to telegraph and telephone switches." R. SNYERS. Dated September 29.

12377. "Distributing electricity." R. P. SELLON. Dated September 29.

12378. "Electrical railway signalling apparatus." H. MERZBACH, S. O. EISELE. Dated September 29.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1885.

11513. "Improvements in appliances for jointing or connecting electric wires." A. WHALLEY. Dated September 28. 8d. The ends of wires to be jointed are first scraped bright, twisted together, and heated in the flame of a candle or other source of heat at the same time. A tube containing solder and resin is heated in the same manner, and as soon as the solder contained in the tube fuses the twisted ends of the wires are inserted in the tube, and when the solder has solidified the fastening and connection is complete. The jointing tube in this way it will be seen is at right angles to the line of the wires jointed. Where it is desirable that the joint and wires should be in one and the same line the inventor brazes to the closed ends of two of the tubes, as above described, a strip of sheet copper or other metal, or short length of copper wire, and when making the joint the connecting strip of metal or wire is doubled or folded so that the open ends of the two tubes are brought side by side and then exposed to the flame of a candle or other source of heat until the solder within the tubes fuses, whereon the ends of the wires to be joined are placed in the tubes, one in each tube; as soon as the solder solidifies the tubes and connecting strip or wire are straightened, there then being a jointing continuous with the length of the wires.

11569. "Improvements in and connected with the laying of electrical conductors in subterranean lines and in the construction of such lines." P. M. JUSTICE. (Communicated from abroad by H. C. Spalding and P. McMackin, both of America.) Dated September 29. 1s. 1d. Relates to means for constructing sheathing and protecting electrical conductors in subterranean lines; for this are employed certain tools, apparatus, and appliances; and a pipe or conduit, composed of an upper and lower section fitted together, combining longitudinal ribs along the joints thereof, with spicket and sleeve ends, and with suitable spouts or branch tubes; the spicket end of one tube fitting loosely into the sleeve of the next, which is slightly contracted at the opening. With the said pipe or conduit are combined non-conducting holders for the electrical conducting wires, in which the said wires are held in position without contact with one another. These holders consist preferably of fusible superposed block segments, placed at intervals apart in the pipe and between the several series of wires. These holders are arranged in the lower sections of the pipe, and, after the wires are in position therein, the upper sections are set in place, thus completing the pipe section. Through openings in the upper section a non-conducting composition is then poured in, filling the interior of the pipe and surrounding the wires. When the composition hardens, the wires are thus held in place and insulated from one another, as well as from external objects. The claims are 29 in number.

11454. "Improvements in voltaic batteries." T. J. JONES. Dated September 25. 8d. Claims:—1. The manufacture of spring clips, wedges, distance-pieces, or equivalent appliances, to be used for maintaining the elements in position in a galvanic battery, of sheet metal wholly covered or enveloped with an insulating, inoxidizable, and insoluble substance, such as celluloid, as described. 2. The various forms of celluloid-coated sheet-metal spring clips and distance-pieces, substantially as described and shown in the drawings for the purpose specified. 3. The manufacture of distance-pieces, for the purpose described, of celluloid-coated wire coiled to a spiral or other form adapted to the purpose.

11573. "Improvements in and connected with electrical cables." P. M. JUSTICE. (Communicated from abroad by H. C. Spalding, of America.) Dated September 29. 11d. The objects of the present invention are to produce a cable with a central strengthening core which shall possess the requisite tensile strength and also to prevent the effects of induction and retardation. The claims are 34 in number.

11652. "Improvements in the manufacture of plates or elements for voltaic batteries." T. J. JONES. Dated September 30. 6d. Claims:—1. The described process of producing porous and coherent masses or plates mainly composed of oxide of lead, which process consists in mixing together an oxide of lead, preferably the monoxide (litharge) and one of the salts specified, whilst the said materials are in a dry condition, and then steaming the dry mixture whilst in the mould as and for the purpose specified. 2. The manufacture of porous and coherent masses or plates mainly composed of oxide of lead, which process consists in mixing together monoxide of lead (litharge) peroxide of lead and of one of the salts specified, whilst the said materials are in a dry state and then steaming the dry mixture whilst in the mould as and for the purpose specified.

11659. "Improvements in battery jars." H. G. ELLERY and J. T. GENT. Dated September 30. 6d. The inventors surround the upper rim of the jar with a hollow receptacle for holding a suitable insulating substance which is not liable to be affected by the condensation of moisture or the action of chemicals, creeping salts, &c. Claims:—1. Providing the rims of battery jars with a hollow chamber such as that described and illustrated in the drawing for the purpose described. 2. The manufacture and use of the improved insulated battery jars described and illustrated in the drawing.

12325. "Improvements in electro-motors." J. RILEY. Dated October 16. 8d. Claims:—1. An annular armature consisting of iron bobbins having projections on the flanges, set end to end on shaft or shafts, and magnetically insulated from each other, substantially as shown. 2. An armature consisting of three soft iron bobbins having iron flanges and projections on the flanges, set end to end on shaft or shafts, magnetically insulated from each other, the projections of each bobbin to be set at such angles to each other as to be equally divided around the circle, and the bobbins to be either solid or built up, substantially as shown. 3. A reversing gear consisting of a lever radiating from shaft or bearing, a brush or wiper on the lever—but electrically insulated from it—bearing on a commutator which gives current alternately to the bobbins of the armature according to the number of bobbins chosen to form such armature, substantially as shown. 4. A reversing gear consisting of a lever, a brush on holder—and bearing on commutator, which—when moved into certain positions "without lifting the brush off" insures self starting either way, or full stop if the motor is running—the current being on—and a second brush bearing on a ring, substantially as shown.

13201. "Improvements in incandescent electric lamps." L. J. CROSSLEY and J. J. HICKS. Dated November 2. 8d. According to the invention the inventors form the said bulbs partly of clear glass and partly of white or coloured enamel, the said enamel serving sufficiently to reflect the light and yet avoid the dazzling effect produced by silvering. Claim:—A bulb or glass for an incandescent electric lamp, blown from a length of tube in which a width or strip of white enamel or glass is embedded, substantially as shown and described and for the purpose stated.

15325. "Improvements in the method of and means for connecting threads of carbon with platinum wire." C. SEEL. Dated December 14. 8d. Claims:—In incandescent lamps; 1. The method of forming a connection between a platinum wire with enlarged ends and the carbon thread, by means of removing the air out of the parts and placed between two dies or plates, and subsequent introduction of black lead paste (or other conducting material which does not become fluid through heat) filling up the spaces between platinum wire and carbon thread as set forth. 2. By the method specified in the preceding claim, the employment of carbon thread of an angular section, compresssd by means of rollers for the purpose of preventing the breaking of the carbon thread, during the operation of connection as set forth.

1886.

741. "Improvements in arc electric lamps. T. STANLEY, A. H. DAVIES, and C. RICHARDSON. Dated January 18. 8d. Claim:—The combination of a wheel of increased size, say between three and seven inches diameter, with some form of escapement (preferably the one shown in the drawing) at its circumference, with a balance wheel or pendulum, to retard and regulate the rotary motion of the said large wheel.

5093. "Improvements in telegraph transmitters." G. W. BALDRIGE. Dated April 12. 8d. Relates to improvements in telegraph keyboard transmitters. The claims are 10 in number.

5940. "Improvements in telephonic apparatus." P. GANNON. Dated May 1. 8d. The principal object of the invention is to provide means whereby a return current is transmitted to the sending station to indicate that the bell at a distant station has sounded in cases where a magneto call apparatus is used. The claims are four in number.

6167. "Improvements in the manufacture of filaments for incandescent electrical lamps." O. R. SWETE and W. C. MAIN. Dated May 6. 4d. Claim:—The manufacture of carbon filaments from Mexican fibre or other suitable vegetable fibre by dipping same into a solution of pyroxiline, drying, reducing to required uniform section, and then carbonising, substantially as set forth.

6345. "Improvements in means for localising faults in submarine telegraph cables or trench lines, which we designate fault searcher." J. GOTT and H. KINGSFORD. Dated May 11. 4d. Relates to an apparatus which the inventors term a "fault searcher," by the aid of which, in conjunction with a telephone or other sensitive current detector, it is easy to determine the moment when the fault comes in board without cutting the cable. The instrument consists of a large number of turns of insulated wire wound round a frame, preferably of semi-circular form. This may be made of gutta-percha, vulcanite, wood, or metal as desired, and may conveniently be fitted permanently on the ship in such a position that the cable shall in passing from the bows in board be made to pass over and very close to that part of the frame which may be appropriately termed the diameter. The ends of the wire wound round the frame are connected by two wires to a telephone, or other sensitive current detector, which may conveniently be placed in the testing room or any other cabin in which comparative stillness may be obtained. Claims:—1. The use of insulated wire arranged in a frame in circuit with a sensitive current detector in the form and for the purposes herein set forth. 2. The terminal insulator mentioned.

6669. "Improvements in electric valves." W. S. JOHNSON. Dated May 18. 8d. The parts are so arranged that when a circuit is closed by some exciting cause external to the valve itself, it is instantly broken by the mechanism of the valve, thus economising in the greatest degree the electric energy. The claims are twelve in number.

6690. "New or improved means and apparatus for boring to great depths for water, coal, or other minerals by the aid of electricity, applicable also to tunnel, drift, and other similar borings." R. RICHARDS and H. R. LANDON. Dated May 18. 8d. According to this invention the power is generated in any convenient place by means of a dynamo machine actuated by steam or other motive power in the usual manner the power being conveyed to the drilling apparatus by a cable of sufficient length. The claims are two in number.

6692. "Improvements in electrical signalling apparatus for railways." C. RETZIUS-EKWALL. Dated May 18. 8d. The chief object of the said invention is to enable an engine-driver, independently of the station officials, to ascertain, by means of certain signals, whether a train is in motion on the part of the line before him either in the same or in the opposite direction to that in which his own train is travelling. This is effected by arranging at every station beyond its most distant points or switches in either direction two signal bells or hands (a pair for each switch) which, by means of conducting wires, are connected with apparatus at the stations, and so disposed that, when a train is passing a certain point outside the station they are caused to operate, thus bringing a bell at the starting station and two bells or hands at the next station into action. The claims are six in number.

7669. "Improvements in electric motors and generators." E. T. HIGHAM and D. HIGHAM. Dated June 8. 8d. Consists of certain improvements in the construction of electro-magnetic motors and electric generators, designed with the view of increasing their efficiency. The claims are 14 in number.

CORRESPONDENCE.

Patents for Dynamos.

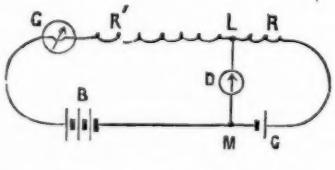
I see in your notes in the issue of September 24th, that Prof. S. P. Thompson has filed a patent, dated June 11th, 1886, for dynamo-electric machines, having the field-magnets of the horseshoe form cast in one piece. I have, prior to June, 1886, both made and sold motors and small dynamos having horseshoe field-magnets cast in one piece, and having either one, two, or three exciting coils. For large machines, especially when shunt wound, the time required for winding is enormous.

G. Bowron.

97, Crawford Street, W.,
September 29th.

Electrical Formulæ.

The formulæ about which "Ajax" inquires may be deduced in the following manner. The same reference letters as those of the figure in your last week's issue are used, the resistance to the left of L being represented by R′.



The current of the battery, B, passing through G and R′ tends to divide at L, part going by D and part by R. The current from the battery, C, tends to flow partly by D and partly by B, G, R′ and R. Since there is no deflection of the galvanometer, D, these currents must neutralise each other and we have

$$\frac{E'}{B+G+R'+\frac{D\,(R+r)}{D+R+r}} \times \frac{R+r}{D+R+r}$$

$$- \frac{E}{R+r+\frac{D\,(B+G+R')}{D+B+G+R'}} \times \frac{B+G+R'}{D+B+G+R'}$$

$= 0$. where E′ and E are the E.M.Fs. of the batteries B and C respectively, that is

$$\frac{E'}{B+G+R'} = \frac{E}{R+r}.$$

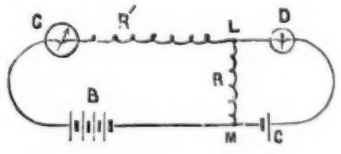
but $\frac{E}{B+G+R'}$ = current through galvanometer, G, and by Ohm's law this is equal to

$\frac{V}{G}$ where V. = difference of potential at terminals, and G. = resistance of galvanometer G.

$$\therefore \frac{V}{G} = \frac{E}{R+r} \text{ whence } V = E\,\frac{G}{R+r}.$$

and since $E = 1{\cdot}072$. $V = 1{\cdot}072\,\frac{G}{R+r}\,n$.

In the second case given the battery, C, is reversed, the galvanometer, D, and the resistance, R, change positions.



Since no current passes through the galvanometer, D, in either direction, it follows that the difference of potential between L and M is just equal to that of the cell, C, that is, since no current flows through C, it is = E. Hence the current through R must $= \frac{E}{R}$. and since no current flows through the branch, D, C, the current through the galvanometer, G, must equal this. That is

$$\frac{V}{G} = \frac{E}{R} \quad \therefore V = E\,\frac{G}{R}$$

$$V = 1{\cdot}072\,\frac{G}{R}.$$

J. Pigg.

5, Pine Street, Newcastle,
September 27th, 1886.

The Marchant Engine.

Four or five years ago, the patentee of an engine recently tested by you called upon me in London, and I wasted the best part of an afternoon in trying to make him see that a good feed-heater was cheaper and simpler than, and every bit as effective as, a wonderful invention, the "entire economical success" of which, according to the latest published account, "rests on the proper action of" an air spring or cushion of no value to any one but the inventor.

It appears to me to "rest" rather upon the brake illustrated on page 277 and designed to relieve the axle of the heavy (?) weight of 720 lbs. "when not running!"

May I suggest that the end of the lever, L, does not move about the centre of the axle, but about some point near E, the "rolling block;" and that the engine may possibly have been giving off 50 H.P., or less, when it was said to be doing 100 H.P. on the brake?

Wm. H. Massey.

Twyford, Berks.,
The Feast of St. Cyprian, 1886.

[Assuming, for the sake of argument, that the engine only gives 50 brake horse-power instead of 100, can Mr. Massey point to another engine which will do the same for the consumption of, say, 1½ lb. of coal per horse-power hour?

Our correspondent, however, ignores the fact that indicator diagrams, which should at least give results within 20 per cent. of the truth, bear out the data obtained by means of the brake.

We hope shortly to hear that further tests have been

completed by experts, whose competence for the task Mr. Massey even cannot gainsay; what the result will be we do not pretend to say, but we see no reason to doubt that the figures will more than corroborate those obtained by us.—EDS. ELEC. REV.]

A New Scale for Tangent Galvanometers.

The skew tangent galvanometer has been known to me about four years. I find from my scribbling book that I was working out its law, and that of a sort of skew dynamometer, in the end of 1882. I was not aware till the other day that Sir William Thomson had since patented the same thing; and I did not patent it myself, or make any fuss about it, because it seemed too obvious to be new. Unless one is continually speaking or writing one has not opportunities of bringing forward odd points of that sort. Two skew instruments were made for me in the summer of 1884, and Mr. Evershed has since designed two more accurate instruments, now, I believe, used by Messrs. Goolden and Trotter. The skewed galvanometer is mentioned in the provisional specification 3,942, of 1885, as I then thought, as I had heard nothing of it in the meantime, it might be new: but on hunting the matter up, I found Marcel Deprez had made an instrument, which was illustrated in your journal in the summer of 1882, and involved the principle. This instrument was of the same sort as Ayrton and Perry's old form of ammeters, but had a skew field.

Messrs. Preece and Kempe seem to have overlooked one point. As the zero is shifted to one side, the point of most accurate reading is shifted towards the centre of the scale. In an ordinary tangent instrument it is at 45°. (See Maxwell, §743.) In a skew galvanometer the current

$$c \propto \tan.\ \phi + \tan.\ \theta,$$

where ϕ is the angle of deflection of the index from the axis of the coil or old zero, and θ the angle the zero on the scale has been moved. The error due to a very small misreading is then

$$\frac{d \tan.\ \phi}{d\ \phi \times (\tan.\ \phi + \tan.\ \theta)} = \frac{1}{\cos.^2 \phi\ (\tan.\ \phi + \tan.\ \theta)},$$

which is least when

$$2 \sin.^2 \phi + 2 \sin.\ \phi \cos.\ \phi \tan.\ \theta = 1$$

i.e., when $\sin.\ 2\ \phi \tan.\ \theta = \cos.\ 2\ \phi$

$$\therefore \cot.\ \theta = \tan.\ 2\ \phi\ \therefore\ \phi = \tfrac{1}{2}\ 90° - \theta,$$

so that the error due to misreading is least at an angle equal to 45° from the axis of the coil, less half the displacement of the zero. With the angle of 60° taken by Messrs. Preece, Kempe, and Eden, this is 15°.

The error due to the coil is least when $\phi = 26°\ 34'$, so that by making $\theta = 36°\ 52'$, the reading for least error due to inaccurate reading is made to coincide with the reading for least error due to the coil. Perhaps, then, 36° would be a better angle than 60°, though the question of convenient range is perhaps more important. The misreading error is obviously least when θ is greatest.

Jas. Swinburne.

My note on the above subject was only intended as a mild protest against old ideas being resuscitated as "discoveries," and I am glad to find Mr. Eden himself makes no claim, as he says the new scale was patented three years ago by Sir W. Thomson. It is very gratifying to find ourselves only three years behind Sir William!

Mr. Eden asks two questions: First, when did Mr. Swinburne publish his discovery? to which I reply, never—he did not claim any discovery, but he certainly mentions the new scale in patent No. 3,942, 1885. Second, Mr. Eden wants to know how my statement that the new scale has been known for years agrees with the date of Sir W. Thomson's patent? I can only say that the two statements agree very well; surely *three* years may be included in *years?*

Sydney Evershed.

Westminster, *September 28th*, 1886.

Primary Batteries for Electric Lighting.

Latterly we have all more or less heard of various new and wonderful batteries being invented which, if we are to believe the statements put forward in respect of capabilities, each one is going to revolutionise the application of electricity for domestic purposes, but on examination the claims in most cases put forward are little if any advance on what are already obtained, the startling prospectuses issued being more often than not prepared for the purposes of Stock Exchange operators who trade on the credibility of the public. Having been engaged in extensive experiments with primary batteries for domestic lighting, the results of my investigation may be of some interest to your readers. Amongst the many forms I have had in practical use, I believe that known as the Holmes-Burke battery has best fulfilled the conditions usually desired, viz., simplicity and ease of management by ordinary attendants, constancy and reliability of current, and cost in working. Although a battery not altogether new as regards its principle, there are details in construction and in the solution employed which form features of novelty and constitute it a sound and practicable battery for use for domestic lighting, and with it it is possible to light the principal rooms of an ordinary residence very satisfactorily, and although the cost must necessarily exceed that of gas, there are so many attendant advantages in the use of this illuminant that the extra cost is very much more than covered. With a battery of 20 cells of this form, I have with one charge run 12 16-candle lamps taking 1½ ampères each for eight hours on one occasion, and two evenings afterwards 10 10-candle lamps taking 1 ampère each for about 4½ hours, and during the following three days, while the battery remained charged, several lamps were occasionally run for the purpose of showing the working, testing, &c., the output altogether equalling over 220 ampère hours. As a quantity battery I believe this form to be unequalled, and although the cost of lighting by chemical action must always greatly exceed that produced by dynamo and mechanical power, the elements in this battery are very inexpensive, and the maximum value appears to be extracted from them in use. I have not yet had an opportunity of trying the chlorine battery of Mr. Upward, which, however, from the description and reports of its principle I should say marks a distinct advance in batteries, but there are complications in its construction and use, and contingencies that may arise in working that render it doubtful whether it could be safely applied in ordinary domestic circles where scientific or mechanical knowledge were wanting, and where such could be obtained the cheaper form of engine and dynamo would be, I consider, safer, and, generally speaking, more reliable. The chlorine battery might, however, come in where objection was strong to motive power and machinery.

The cost of lighting by battery power can never fall much below 1d. per 45 watts, although some of the records of the Holmes-Burke battery are a little more advantageous, but with gas engine and dynamo the cost is considerably reduced. I am now running from a 1 horse-power gas engine and dynamo 14 16-candle lamps at a cost of 1½d. per hour for gas, and allowing for oil, waste, &c., depreciation on plant, lamp renewals, &c., during an average of 1,500 hours per annum, the cost comes out at little over ¼d. per lamp, equal to 45 watts per hour. In a larger installation a still greater advantage would be obtained, but speaking of batteries and for batteries, the one I have spoken of is in my experience amongst the foremost for practical use.

Henry T. Crewe.

16, Montpelier Vale, Blackheath, S.E.,
27th September, 1886.